

# ABC IN ICU



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الحمد لله وشكراً جزيلاً لكل من عاونا من معلمينا  
وأصدقائنا وكل من ساهم في نشر هذا العلم .

كل كلمة مكتوبة في الملزمة في عيانيين اضرروا  
قصاها فبعد إذك بلاش اختراع العجلة واهتم  
بكل حرف مكتوب ومتقولش ده ملوش لزمة .

# Contents

<i>Introduction .....</i>	<i>4</i>
<i>How to present a case .....</i>	<i>8</i>
<i>Care of chronic devices.....</i>	<i>15</i>
<i>Ventilation .....</i>	<i>18</i>
<i>ARDS .....</i>	<i>29</i>
<i>Oxygen therapy .....</i>	<i>32</i>
<i>Blood gases .....</i>	<i>33</i>
<i>Shock .....</i>	<i>40</i>
<i>Myocardial infarction .....</i>	<i>43</i>
<i>Arrhythmia.....</i>	<i>47</i>
<i>Tachy-arrhythmia.....</i>	<i>49</i>
<i>Atrial fibrillation .....</i>	<i>51</i>
<i>Post-arrest protocol .....</i>	<i>55</i>
<i>Sepsis &amp; septic Shock .....</i>	<i>57</i>
<i>Burn.....</i>	<i>59</i>
<i>Antibiotics.....</i>	<i>63</i>
<i>Traumatic brain injury .....</i>	<i>69</i>
<i>Ischemic stroke .....</i>	<i>74</i>
<i>Acute kidney injury .....</i>	<i>76</i>
<i>Chronic kidney disease .....</i>	<i>80</i>
<i>Diabetic keto-acidosis .....</i>	<i>82</i>
<i>Hepatic patient.....</i>	<i>85</i>
<i>IV fluids .....</i>	<i>88</i>
<i>Drugs Infusion.....</i>	<i>90</i>
<i>Nutrition .....</i>	<i>94</i>
<i>Extras .....</i>	<i>99</i>

## INTRODUCTION

الرعاية ليها شق إداري وشق طبي ...

الشق الإداري لو مش متضبط كويس عُمر الشق الطبي ما هيبقى كويس ... مثلاً  
intubation box, crush trolley, CVL insertion tray, opioids  
والمونيتورز .

وتوزيع التمريض ومخزن ومستلزمات ومعدلات صرف وورقيات و patient files  
و data system ... لازم في حد معين مسئول عن الكلام ده بمتابعة حد من  
الدكاترة ...

لا تظن إن دي حاجات أساسية دائماً موجودة by default ... لو مفيش regular  
check up هتيجي في وقت مش هتلاقي منظار شغال تتيب بيه أو أدوات تركيب  
CVL أو غيره .

ثق تماماً إن أي شخص هتديله مهمة وتسبيه من غير ما تراجعهُ يومياً لمدة أسبوع  
هيوقعها .

لازم team أي رعاية يتقابل بانتظام ويتكلموا بانتظام ويبقى ليهم جروب واتس .

لو مفيش حاجة بتزق الرعاية لقدام (أجهزة وغيره) مع الوقت هترجع لورا .

الشق الطبي هو الملزمة دي والمذاكرة .



## التعامل مع أهل العيان

لما عيان يدخل الرعاية لازم نوضح خطورة الحالة للأهل بنسب مئوية مرتفعة ... يعني تقولهم في 70% خطورة على حياته في أول 24 ساعة بسبب الأمراض المزمنة اللي عنده زي السكر والضغط والقلب والكبد والكلى وغيره من الأمراض الموجودة عنده وكانت مهمة ، أو المرض الطارئ اللي حصله زي تسمم في الدم نتيجة انفجار في الأمعاء أو غرغرينا في الساق أو غيبوبة نتيجة الحادثة اللي عملها ... وبنوضح إن إحنا هنعمل اللي علينا وزيادة وهنعالجه بكل ما نملك وناخد بكل الأسباب ... لكن زي ما في أسباب الأرض في أسباب السماء .

متعملش attack لنفسك بغاوة ملهاش مبرر ... متقولش مثلاً إن العيان جاله التهاب رئوي بسبب جهاز التنفس الصناعي ... انت بتبرز وتوضح إن حالته متدهورة لنفس السبب اللي دخل عشانه الرعاية .

طبطب على أهل العيان وبين إنك مقدر حجم الابتلاء وإنهم هيوجروا عليه وانت بتفهمهم خطورة الحالة .

دايماً بنحط الأهل في Grey zone ... لو العيان متكحول يبقى ناحية الـ Dark grey ولو العيان كويس يبقى ناحية الـ Light grey حتى لو هتخرجه ثاني يوم لأنه أكيد لسه قاعد عشان حاجة فلو اتكحول لا قدر الله تلاقي حاجة تقولها للأهل .

الجعجة في وجود جماهير عريضة أو ناس عصبيين غباء غير طبيعي !

في لحظات بتبقى لحظات امتصاص وتقدير الفاجعة .

من وظائفنا إننا نفهم أهل العيانيين ومنستخباش وقت الزيارة ... ولو عددهم كبير اطلب اثنين أو ثلاثة على جنب تفهمهم الحالة .

## بنعمل إيه الصبح

- ◀ كل نايب وزميله اللي قصاده بياخد 3 عيانيين يقللهم ... العيان الجديد مع اللي كان نبطشي .
- اسحب بنفسك blood gases for the most critical patients وسجلها .
- لو الـ pH أقل من 7.25 أو أكثر من 7.55 بلغ المدرس المساعد أو استنى المرور وابعثها ع الجروب.
- Adjust ventilator parameters according to blood gases.
  - If severely acidotic & not ventilated give  $\text{NaHCO}_3$  or arrange for dialysis.

- Labs: Fulfilled in lab sheet & document lactate &  $\text{FiO}_2$ .
  - Balance → check the trend over last 6 hours.
  - Problems → acute & chronic.
  - Fluids:
    - Volume & content → Adjust according to labs & ABG & acute problems.
    - Check nurse sheet carefully.
    - Adults: 25-30 ml/kg/day & re-assess in case of DKA, change in UOP or Na level.
    - Pediatrics: اسأل المدرس المساعد
- ◀ الحاجات اللي بنبليج بيها التمريض 9 الصبح :
- Dialysis, Number of patients undergoing dialysis & patient preparation.
  - CXRs
  - Cultures (يوم الخميس في مزرعة دم).
  - مواعيد تعقيم البلازما: الأحد - الثلاثاء - الخميس

- Check list:

حد مسئول عنها ولو في مشكلة يبلغ ع الجروب ويبلغ التمريض وبعدها بساعة يقول حصل إيه .
- Drugs: حد مسئول عن صرفها

## **Management of critical care patient**

### ➤ **ACUTE PROBLEMS**

CNS	CVS
<ul style="list-style-type: none"> <li>• DCL</li> <li>• Convulsions</li> <li>• Spinal cord injury</li> </ul>	<ul style="list-style-type: none"> <li>• Shock &amp; active bleeding</li> <li>• Chest pain (MI &amp; Dissecting aortic aneurysm &amp; pancreatitis)</li> <li>• Arrhythmias</li> <li>• Hypertensive emergency</li> <li>• Infective endocarditis</li> <li>• Limb ischemia</li> </ul>
Respiratory	Hepatic
<ul style="list-style-type: none"> <li>• Hypoxia</li> <li>• Complicated tracheostomy</li> <li>• Complicated chest tube</li> <li>• Surgical emphysema</li> <li>• Flail chest</li> </ul>	<ul style="list-style-type: none"> <li>• Hepatic encephalopathy</li> <li>• Hematemesis</li> <li>• Hepatorenal syndrome</li> <li>• Spontaneous bacterial peritonitis</li> <li>• Hepatoadrenal syndrome</li> <li>• Hepatopulmonary syndrome</li> </ul>
GIT	Renal
<ul style="list-style-type: none"> <li>• Vomiting</li> <li>• Leakage (including drains)</li> <li>• Wound → dehiscence or infection</li> <li>• Stoma → non-functioning or retracted</li> <li>• Ryle → non-functioning: intake or drainage.</li> <li>• Nutrition</li> </ul>	<ul style="list-style-type: none"> <li>• AKI</li> </ul>
Back & lower limbs	Labs
<ul style="list-style-type: none"> <li>• Bed sores</li> <li>• DVT</li> </ul>	<ul style="list-style-type: none"> <li>• Any abnormality</li> </ul>

☞ For any acute problem → Diagnosis & Treatment.

☞ Consider the possibility of multifactorial etiology for the acute problem → Continue the whole differential diagnosis → e.g, combined septic & cardiogenic shock.

لو في حاجة تمنع ال diagnosis حاول تشغل دماغك ...

مثلاً عيان Hepatic + DCL + high inotropic support ... حالته متسمحش تنزله يتصور CT brain  
... هتعتبره hepatic encephalopathy ... بس لو عنده signs of lateralization يبقى غالباً في  
حاجة central وساعتها خد الريسك وانزل صوره .

➤ **CHRONIC PROBLEMS:** Diabetes, hypertension, IHD, etc.

# HOW TO PRESENT A CASE

◆ Name                      ◆ Age                      ◆ Gender

**Medical history** → e.g, DM, HTN + Analysis: duration, treatment & complications.

**Surgical history** → Mention it if relevant.

**Cause & date of hospital admission**

**Surgical intervention if present**

**Cause & date of ICU admission + Day**

قول القصة في صورة حكيوة لطيفة chronological ... مثلاً عيان اتحجز في المستشفى  
بـ acute abdomen وعمل exploration فطلع DU perforated ... حطوا omental patch ... في العملية  
ضغطه وقع واتحط على ليفو فطلعوه الرعاية .

☞ Cause of hospital admission: Acute abdomen, exploration revealed perforated DU for which omental patch was done ... Cause of ICU admission: hemodynamic instability.

☞ **Mention the trauma survey in traumatic cases in terms of specialities:**

- Neurosurgery:

- ☞ In case of DCL with free CT brain → Post-concussion or diffuse axonal injury → consider MRI with diffusion & EEG.

- ☞ Any fracture spine → Neurological assessment & stability of fracture ± Solumedrol.

- Cardiothoracic:

- ☞ In case of flail chest → Ensure adequate pain control with epidural analgesia or morphine infusion.

- Surgery: General, Vascular & Plastic surgery.

- Orthopedic, ENT & Ophthalmology.

**Picture on admission** →→ **Sequence of events** →→ **Picture now**

يعني تمسك كل system في العيان من أول ما دخل وحصل فيه إيه ودلوقت وضعه إيه وبعدين تدخل  
ع ال system اللي بعده .

## 1) CNS

➤ GCS: ★ If fully conscious & ventilated → Mention the medications used for sedation.

Target RASS score: -1 to -3 → see later.

★ If DCL: Mention the GCS in details then mention the following items:

➤ **Pupils & signs of lateralization.**

➤ **CT brain** → In case of DCL with free CT brain → Repeat after 48 hrs.

➤ **Others:** e.g, EEG & MRI with diffusion in case of convulsions or DCL not explained by CT brain or unexplained tachycardia (may be sub-convulsive fits).

## 2) CVS

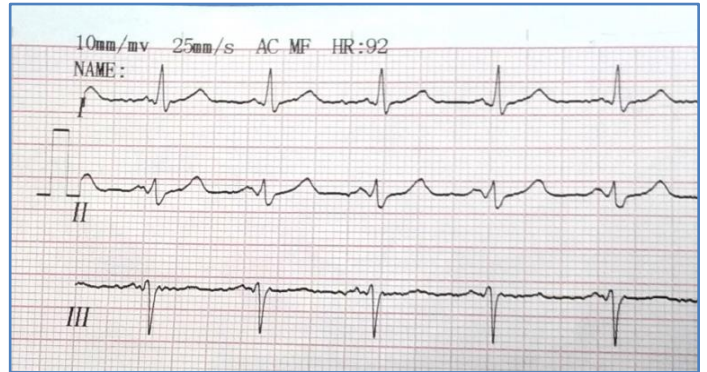
➤ ABP & HR, On inotropes or not ?? If yes → **Mention the DD of shock (see shock).**

➤ ECG: قبل ما تحكم على رسم القلب لازم تتأكد إنه معمول صح

1. Voltage: 10 mm/mv (2 large squares).
2. Speed: 25 mm/sec (sec = 5 large squares).
3. aVR → inverted waves.
4. Compare with previous ones to detect dynamic changes.
5. Topography.
6. Assess: Rate, Rhythm & Waves.

### **Topography:**

- Septal → V1, V2
- Anterior → V3, V4
- Lateral → V5, V6, I, aVL
- Antero-septal → V1, V2, V3, V4
- Antero-lateral → V3, V4, V5, V6, I, aVL
- Inferior → II, III, aVF.



### ➤ **Echo:**

- شمال → Left ventricle contractility (EF),
- يمين → Right ventricle dimensions (dilated or not),
- بره → Pericardium (there is effusion or not),
- جوه → Fluid status.

➤ **Cardiac enzymes:** Only in shocked cases ... If cardiogenic shock is suspected by Echo or ECG changes → Repeat after 2 hrs then every 8 hrs.

## 3) CHEST

### ➤ **Auscultation.**

➤ **Imaging:** CXR (see below) ± CT chest or lung ultrasound.

### ➤ **On room air or oxygen therapy.**

If on oxygen therapy → Venturi mask or Nasal cannula (flow ?).

If ventilated → Ventilation parameters ??

### ➤ **ABG.**

±➤ **ABG after re-adjustment of ventilator parameters.**

±➤ **Differential diagnosis of hypoxia.**

### **Chest x-ray**

1. **CVL:** Site & position + بتأكد منها إن الصورة دي بتاعة العيان ده
2. **Lung borders:** Look for pneumothorax.
3. **Copula:** If flattened suspect pneumothorax.
4. **Gastric air bubbles:** If distended → ryle malfunction (obstructed or not in place).
5. **Trachea:** Central or not.
6. **Routine:** Cardiothoracic ratio, pneumonic patches & costophrenic angles.

## **Differential diagnosis of hypoxia**

### **1. Chest auscultation:**

- ★ Diminished unilateral: collapse - endobronchial tube - هواء - ميه - دم
- ★ Diminished bilateral: obstructed tube, bronchospasm or pleural effusion.

### **2. Imaging:**

- ♦ CXR or CT chest → pneumonia, pneumothorax, ARDS, endobronchial tube ± Lung ultrasound.
- ♦ Lung ultrasound → pneumothorax.

### **3. Echo:**

- ♦ Right side: Dilated in case of pulmonary embolism.
- ♦ Left side: Poor contractility is suggestive of heart failure & pulmonary edema.

### **4. Numerics of ventilator:**

- ♦ Check the peak airway pressure, plateau pressure & the tidal volume.
  - ↑peak & ↑plateau → ↓compliance.
  - ↑peak & normal plateau → obstruction.
- Pleural effusion → chest tube ركب ساعات 6 واقفلها 500 سم سيبها تنزل to avoid negative pressure pulmonary edema + lasix
- Any hemothorax is an indication for chest tube as it doesn't resolve with diuretics.

## **4) GIT**

➤ أي عيان في بقه أنبوبة لازم تحطله رايل

➤ Oral or ryle feeding? If ryle mention why?

➤ Ryle:

- Don't insert the ryle orally in non-intubated patient as it may lead to regurgitation & aspiration.
- If for feeding → Ryle test & flush to avoid food fermentation → avoid gastritis.
- If for drainage → Consult when to start feeding & flush to determine if obstructed. Check gastric air bubbles in CXR: If distended → ryle malfunction (obstructed or not in place).
- In case of persistent vomiting → stop oral/ryle medications, shift to IV alternatives & give prokinetics.

➤ Feeding:

- Start enteral feeding as soon as possible unless contraindicated (GIT surgery). Small bowel → after 3 days ... Large bowel → 5 days ... Perforated DU → 7 days.
- Don't rely on intestinal sounds to start enteral feeding because 50% of patients with inaudible intestinal sounds have normal peristalsis.

➤ Care of wound if present:

- Colostomy → viability(color), retraction (if retracted may lead to peritonitis or necrotizing fasciitis) & output & dressing/ 4 hrs to avoid soiling.

• لو في abdominal incision والعيان بقى ambulant هتطلب من أهل العيان 4 أحزمة بطن (Abdominal binders) حزام لجرح البطن وحزام لل stoma فيه فتحة ليها ... وحزامين احتياطي عشان لو الموجودين احتاجوا يتغسلوا . لو مفيش stoma يبقى حزامين فقط . لو مش ambulant وال peak عالي ← الحزام ممكن يكون السبب ← شيله .

➤ Drains:

- Output.
- Remove if not needed.

## 5) **BACK & LOWER LIMBS:**

- Look for edema & bed sores.
- Capillary refill.

## 6) **LABS.**

7) **BALANCE** : Follow up the trend over every 6 hours & the cumulative balance in last days.

## 8) **FEVER, TLC, CRP, CULTURES & PROCALCITONIN.**

## 9) **CHRONIC DEVICES CARE:**

Such as tracheostomy tube, chest tube, urinary catheter, CVL & surgical drain.

Care in the form of → Duration, signs of infection, disinfection, working or not? needed or not?

- ☞ CVL position: 2<sup>nd</sup> rib anteriorly in CXR.
- ☞ Maximum duration for CVL: 2 weeks ... 10 days in patients with liver or renal transplantation.
- ☞ Maximum duration for urinary catheters: Foley: 3 weeks ... Silicone: 1.5 - 3 months.

## 10) **TREATMENT** → قاعد ليه وبنعمله إيه؟

### 1. ABC:

يعني العيان يكون ماسك ضغط و saturation خلال نص ساعة .

- ♦ AB → see tube insertion & ventilation settings pages 16 & 17.
- ♦ C → DD of shock + management of cause (with relevance to hypoxia → قلة المحاليل).

### 2. Specific treatment: Refer to protocol.

### 3. The 4 Anti:

- ♦ Antibiotics → according to protocol.
- ♦ Antacid: Zantac 50 mg amp/8 hrs (first line) or Losec 40 mg vial /24 hrs.
- ♦ Analgesic & Antipyretic: Perfalgan 1 gm vial/ 6 hrs.
- ♦ Anticoagulant: Start as soon as possible unless contraindicated:
  - Active bleeding from the wound or any body orifice.
  - Intracranial hemorrhage or brain contusion → start on day 4.
  - Suspected bleeding by surgeons.
  - Platelets < 50,000.

**Alternative: Intermittent leg compression (pneumatic cuff).**

- ☞ Start with Clexane 40 mg SC once daily.
- ☞ In case of BMI > 40 : Clexane 40 mg SC/ 12 hours.  
In case of BMI > 50 : Clexane 60 mg SC/ 12 hours.
- ☞ In case of renal impairment: Heparin 5000 U SC / 12 or 8 hours.
- ☞ In case of renal impairment + BMI > 40 : Heparin 7,500 U SC/ 8 hours.
- ☞ In case of thrombocytopenia: Switch to Arixtra (fondaparinux)  
or Thrombex (hirudin).
- ☞ Suspect HIT after day 4 or earlier with history of previous exposure to heparin.

### **Thrombocytopenia**

Hemolytic Uremic Syndrome (HUS)	Thrombotic Thrombocytopenic Purpura (TTP)
Neurological manifestations	Hypercoagulable state (DVT, Stroke)
Renal impairment	Thrombocytopenia
Thrombocytopenia	
<b>DD:</b> LDH, Blood film (schizocytes) & Coomb's test.	

### Anticoagulants

	When to stop <b>before</b> regional	When to start <b>after</b> regional
<b>Clexane</b>	12 hrs if prophylactic, 24 hrs if therapeutic	2 hours
<b>Heparin</b>	4 hours	1 hour
<b>Arixtra</b>	36 hours	
<b>Thrombex</b>	10 hours	
<b>Antidote to Heparin: Protamine sulphate</b> 1 mg to each 100 IU heparin → 50 mg shots every 10 minutes. If given 1 or 2 hours late give half the dose		

### Thrombex dose adjustment according to Creatinine Clearance

> 60	30-60	< 30
15 mg/12 hrs	5 mg/12 hrs الأمبول يتسحب على سرنجة انسولين وندي العيان 33 شرطة	1.6 mg/12 hrs الأمبول يتسحب على سرنجة انسولين وندي العيان 11 شرطة

☞ Thrombex ampoule: 1 ml containing 15 mg.

#### 4. Treatment of co-morbidities:

e.g, Hypertension → Continue on previous treatment unless contraindicated, e.g, shock.  
Diabetes → Insulin, statin & becozyme.

#### 5. Treatment of examination findings:

e.g, Wheezy chest → bronchodilators.

☞ **In wheezy chest:** Use corticosteroids that have a predominant glucocorticoid effect i.e, Solumedrol (not solucortef which is predominantly mineralocorticoid).  
Dose: IV: 125 mg/6-8 hours, Oral: Solupred 30-60 mg/24 hours

#### 6. Treatment of labs:

e.g, ↓↓ K<sup>+</sup> → Target 4.5 mEq/L ... But in renal patients; the target is 3.5 mEq/L with cautious correction (2 ampoules then reassess). **ويتعاد في نفس اليوم**

↑↑ creatinine → Daily calculation of creatinine clearance وينكتب في ورق العلاج  
+ drugs adjustment.

☞ لو شكيت إن نتيجة المعمل غلط عيده خلال نص ساعة .

#### 7. Vitamins + Nutrition: especially in burn patients ... Consider formulas.

#### 8. Ventilator care bundle:

1. Anticoagulant.
2. Antacid.
3. Oral care → Chlorhexidine (DG care).
4. Head elevation 30°.
5. Daily sedation vacation unless contraindicated → status epilepticus, brain edema & ARDS.
6. Assessment of readiness for weaning → If ready: spontaneous breathing trial / 24 hrs.



## 9. Care of comatose:

- DG care & oxypol.
- Care of bowel → laxative or enema.
- Frequent repositioning to prevent bed sores.
- Treatment of bed sores:
  - 1<sup>st</sup> degree → Mebo, 2<sup>nd</sup> degree → Aeroxol, 3<sup>rd</sup> degree → Surgical debridement.
- Treatment of constipation with laxatives.
- Assessment for DVT: Well's score.

## 10. Physiotherapy & Out of bed:

حتى لو انت متضايق و العيان متضايق والتمريض متضايق هيقعد علي كرسي ... احنا مش جايين ننفذ طلبات المريض

## 11. Hopeless case:

1. الجثة سليمة
2. Pain free
3. حسن الخاتمة



- ◀ ازاى ايد العيان تتربط في السرير؟؟ ← 2 دريسنج مقفولين ببلا تسر عشان ميفرولوش ← لفهم حوالين رسغ العيان وعدي من تحتهم رباط شاش مربوط في السرير فالعيان لو شد ايده ← رباط الشاش هيشد ع الدريسنج مش على ايده.
- ◀ ازاى تثبت الأنبوبة برباط شاش من غير ما يشد على بوق العيان؟؟ ← شاشة على moth angles تحت رباط الشاش أو دريسنج مخروم.
- ◀ لو العيان بيشد الرايل ← حظ قطن في ايده واقفل عليه بجوانتي بالعكس زي البوكسنج.
- ◀ لو مفيش airway متحطش سرنجة في بوق العيان .
- ◀ لو عيان مات ومركب CVL وبعد ما اتشالت بتجيب دم ومبتقش اقلها بغرزة ← يخرج بغرزة احسن ما دمه يتصفى.

### Wells Clinical Prediction Rule for Deep Venous Thrombosis (DVT)

Clinical feature	Points
Active cancer (treatment within 6 months, or palliation)	1
Paralysis, paresis, or immobilization of lower extremity	1
Bedridden for more than 3 days because of surgery (within 4 weeks)	1
Localized tenderness along distribution of deep veins	1
Entire leg swollen	1
Unilateral calf swelling of greater than 3 cm (below tibial tuberosity)	1
Unilateral pitting edema	1
Collateral superficial veins	1
Alternative diagnosis as likely as or more likely than DVT	-2
Total points	

DVT = deep venous thrombosis.

Risk score interpretation (probability of DVT):

- $\geq 3$  points: high risk (75%);
- 1 to 2 points: moderate risk (17%);
- $< 1$  point: low risk (3%).

### Richmond Agitation Sedation Scale (RASS)

Score	Term	Description
+4	Combative	Overtly combative, violent, immediate danger to staff
+3	Very agitated	Pulls or removes tube(s) or catheter(s); aggressive
+2	Agitated	Frequent non-purposeful movement, fights ventilator
+1	Restless	Anxious but movements not aggressive vigorous
0	Alert and calm	Fully conscious & not-intubated
-1	Drowsy	Not fully alert, but has sustained awakening (eye-opening/eye contact) to voice (>10 seconds)
-2	Light sedation	Briefly awakens with eye contact to voice (<10 seconds) →→ <b>Target score</b>
-3	Moderate sedation	Movement or eye opening to voice (but no eye contact)
-4	Deep sedation	No response to voice, but movement or eye opening to physical stimulation
-5	Unarousable	No response to voice or physical stimulation

#### Procedure for RASS Assessment

1. Observe patient
  - a. Patient is alert, restless, or agitated. **(score 0 to +4)**
2. If not alert, state patient's name and say to open eyes and look at speaker.
  - b. Patient awakens with sustained eye opening and eye contact. **(score -1)**
  - c. Patient awakens with eye opening and eye contact, but not sustained. **(score -2)**
  - d. Patient has any movement in response to voice but no eye contact. **(score -3)**
3. When no response to verbal stimulation, physically stimulate patient by shaking shoulder and/or rubbing sternum.
  - e. Patient has any movement to physical stimulation. **(score -4)**
  - f. Patient has no response to any stimulation. **(score -5)**



# Chest Tube Care

## For Insertion

1. Respect hierarchy:  
قلب و صدر - جراحة - رعية ... حسب المكان التي انت فيه
2. Witnessed & pain-free.
3. Patient preparation:  
- Platelet count & INR especially if hepatic.  
- Stop dexane if therapeutic unless urgent.
4. CXR → check copula of diaphragm on right side, if elevated (liver) → check copula of diaphragm on right side, if elevated (liver) → check copula of diaphragm on right side, if elevated (liver)
5. Prepare for the procedure:  
- صبغية تعقيم.  
- برطمان ملين ٥٠٠ سم و بلاستر باطلون وكل يوم يتعلم ومتفائل فتحات البرطمان.  
- خيط 1/0 Silk
6. Connect  
- الأنبوية واصلة على الفتحة الطوية التي فيها صود تحت سطح المياه وتترك بلاستر عشان محدش يكسها ويوصلها بفتحة غلط فتدخل هوا جوه صدر العيان
7. CXR after insertion.  
In hepatic patients → pigtail is more preferred than chest tube in pleural effusion due to poor healing after removal.

## While in Place

### 1. blood, serous, pus

- To avoid negative pressure pulmonary edema: Empty 500 ml/8 hrs → Then 500 ml/12 hrs → Then keep it open.
- If draining > 200 ml blood/hr after drainage of the main bulk → consider active bleeding → for surgical intervention.
- 10-14 days → risk of empyema → for surgical intervention.

افرك عشان تتشال → risk of empyema

### 2. هوا

تتعلم بماركر كل ٦ ساعات عشان لو بتزيد ناخذ بالنا

لو راكبة وسالكة بس ال-empyema لسه بتزيد ←

### ➤ Air leak:

- ☞ Use the lowest possible tidal volume & PEEP to allow healing.
- ☞ In case of excessive air leak affecting oxygenation → consider lung isolation till healing occurs → If still affecting oxygenation → consider surgical repair.
- ☞ If air leak persists for > 10 days → consider major tracheal or bronchial tear for surgical repair.

➤ **Oscillation:** If stopped → either lung expansion, chest tube obstruction or endobronchial obstruction → Do CT chest.

### ➤ Persistent Pneumothorax:

- ☞ lung mediastinal window مش راشقة في ال lung
- ☞ **Bronchoscopy** → Confirm bronchi patency.
- ☞ **Obstructed tube** → Insert another chest tube.
- ☞ **Connect to low vacuum.**
- ☞ **Pleural thickening (mediastinal window)** → Consider decortication.

### 4. Transport:

☞ **Daily 3** ← شرتك انيا oscillating والخروم جوه .... وقلب و صدر بمر تتفعل كويس أثناء النقل و متطلعش فوق مستوى العيان وكل ما تيجي فرصة انزلها واقتحها عشان ميتشش

## After Removal

1. Clamp for 4-5 hours before removal then do CXR:  
• If pneumothorax recur → open it again.  
• If not → remove then do CXR.
2. Any diminished air entry → consider pneumothorax (once pneumothorax always pneumothorax).

### **Care of CVL**

1. CXR: Site: بتأكد منها إنها بتاعة ده  
Position: 2<sup>nd</sup> rib anteriorly.  
Not complicated with pneumothorax.
2. Back flow.
3. Not infected.
4. Covered with sterile dressing.
5. Dated.
6. مقفولة بغطيان.



# Ventilation

$$P = \text{Peep} + V \times 1/C + RF$$

P is peak pressure

$V \times 1/C$  is the difference between plateau & peep

RF is the difference between peak & plateau

## **Indications of intubation (Inability to protect the airway)**

1. Anesthesia.
2. Bulbar palsy.
3.  $GCS \leq 8$ .
4. Continuous trickling, e.g, fractured nose.
5. Capacious secretions and inability to cough.

## **Indications of ventilation**

1. Impaired mechanics:  $RR > 35/\text{min}$ ,  $VC < 15 \text{ ml/kg}$ , Inspiratory force  $< 25 \text{ cmH}_2\text{O}$ .
2. Impaired oxygenation:  $\text{PaO}_2 < 60 \text{ mmHg}$  on  $\text{O}_2$  mask, shunting  $> 20\%$ ,  $P(A-a)\text{O}_2 > 350 \text{ mmHg}$  with  $\text{FiO}_2 = 1$ .
3. Impaired ventilation:  $\text{PaCO}_2 > 60 \text{ mmHg}$  with no COPD,  $\text{TV} < 5 \text{ ml/kg}$ ,  $\text{VD-VT ratio} < 0.6$ .

## **Initial settings of ventilation**

- Mode: CPAP or Assisted controlled  $\rightarrow$  volume controlled & pressure controlled.
- $\text{FiO}_2$ : initially 100%  $\rightarrow$   $\downarrow$ gradually if hypoxic or  $\downarrow$ directly to 40 % if not hypoxic.
- Tidal volume: 6-8 ml/kg according to  $\text{CO}_2$  & pH ... Apply inspiratory pause 10-20% in VCV.
- RR: 20  $\rightarrow$  Modulate according to blood gases  $\rightarrow$  e.g,  $\uparrow$ RR in metabolic acidosis.
- Driving pressure: less than 15  $\text{cmH}_2\text{O}$  unless  $\uparrow\text{PCO}_2$  despite maximum RR causing:
  - DCL ( $\text{PCO}_2 > 60$ )
  - $\text{pH} < 7.15$
  - Hemodynamic instability

In such cases elevate the driving pressure & pressure limit.

- IE ratio: 1:2 or inspiratory time: 0.7 -1.2
- PEEP:
  - If  $\text{FiO}_2 > 40\%$   $\rightarrow$  PEEP has to be  $> 5$
  - If PF ratio  $> 150 \rightarrow 8-12$  ... If PF ratio  $< 150 \rightarrow 12 -15 \text{ cmH}_2\text{O}$ .
  - In case of broncho-pleural fistula (air leak) or Rt side pathology as pulmonary embolism  $\rightarrow$  use least possible PEEP.
- Pressure limit: Elevate in case of CPR, bronchoscopy & severely hypercapnic COPD.

## Criteria of weaning

Non Respiratory	Respiratory
<ol style="list-style-type: none"> <li>1. CNS: GCS &gt; 8</li> <li>2. CVS: <ul style="list-style-type: none"> <li>- Minimal dose of inotropes</li> <li>- HR doesn't increase &gt; 20% from baseline</li> </ul> </li> <li>3. GIT: not abdominal compartmental</li> <li>4. Metabolic: absence of any of the following: <ul style="list-style-type: none"> <li>- Fever/ Hypothermia</li> <li>- Metabolic acidosis</li> <li>- Severe anemia</li> <li>- Electrolyte disturbances</li> <li>- Hypoglycemia</li> </ul> </li> </ol>	<ol style="list-style-type: none"> <li>1. PF ratio &gt; 200</li> <li>2. Rapid Shallow Breathing Index (RSBI): Respiratory rate / Volume in liters  <ul style="list-style-type: none"> <li>&gt; 105 → weaning will fail.</li> <li>&lt; 105 → good chance for successful weaning.</li> <li>&lt; 70 → higher chance of successful weaning.</li> </ul> </li> <li>3. Driving pressure &lt; 15 cmH<sub>2</sub>O with adequate tidal volume &gt; 4 ml/kg/</li> <li>4. Minimal or no secretions.</li> <li>5. Adequate cough reflex.</li> <li>6. Create negative pressure &gt; 20 cmH<sub>2</sub>O .</li> <li>7. pH not less than 7.</li> <li>8. PCO<sub>2</sub> &lt; 60 in non COPD patients.</li> </ol> <p>In COPD patients hypercarbia is allowed till it starts affecting the pH.</p>

➤ If being weaned on CPAP → Set the apnea time 20-30 seconds.

If failed → increase apnea time up to 1 minute (you can leave the patient).

Or SIMV with RR: 3 (stay next to patient for 15 minutes).

العيان الملطوط من كذا جهة متديهوش ... weaning trial  
e.g, DCL 12/15 on levo 5 with weak cough reflex

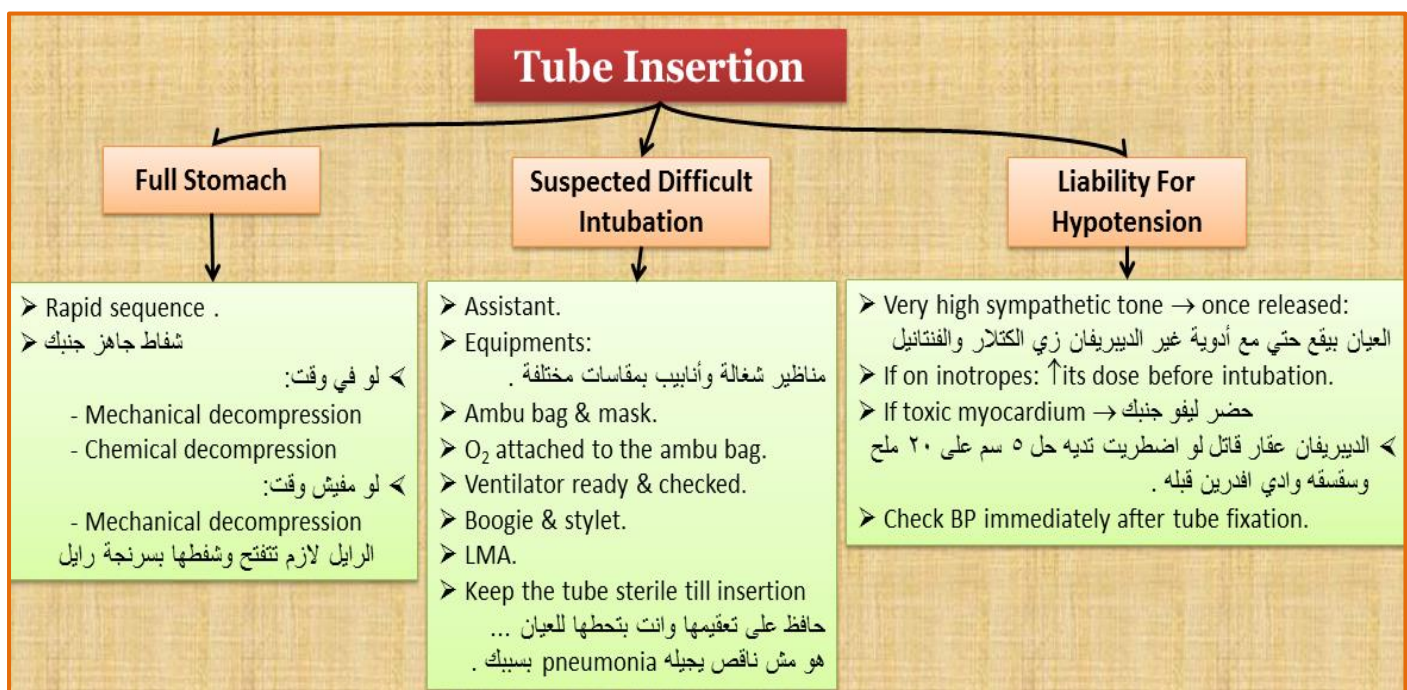
## Difficult weaning

☞ Patients with failed weaning trial or has one risk factor ملطوط من جهة واحدة

☞ How to wean:

- Pressure support 5, PEEP 5 for 1 hour.
- T-tube for 1 hour.
- Controlled for 1 hour.
- Then extubate.

☞ If no T-tube available → Pressure support 5, PEEP 5 for 1 hour → then Pressure support 0, PEEP 5 for 1 hour → then controlled for 1 hour → then extubate.



## Tube Exchange

1. اعلى بـ  $\text{FiO}_2$  لـ 100 %
  2. أتأكد إنه بياخد volumes كويسة
  3. The same as tube insertion
  4. ادخل بالمنظار وهات view والأنبوبة اللي هتنتشال لسه في مكانها
  5. شفط كويس من الـ oropharynx
  6. جهاز قسطرة ثانية معاك
  7. شيل الأنبوبة ودخل الأنبوبة الجديدة للآخر ← لو مدخلتش يبقى في distal obstruction
  8. انفخ الـ cuff ومنتساش تنزل بـ  $\text{FiO}_2$
  9. لو في excessive saliva ← ثبت ببلاستر الأول تخشينة تحت الشاش
- ☞ الله يسترك ويا رب أبوك يحجج لو الـ peak على أول حاجة تعملها غير الأنبوبة .

## Tube Obstruction

1. Exclude other causes of high peak (DD of hypoxia).
2. Ambu bag with saline.
3. Close the pressure releasing valve.
4. Make sure valve at the back of ambu bag is working.
5. Fiberoptic bronchoscopy
6. لو مفيش fiberoptic هات أنبوبة مقاسها أصغر ودخلها من الأنبوبة اللي راكبة (rolling movement) ووصلها على شفط واخرج بيها ... خلي بالك ده ممكن يعمل pneumothorax .
5. Cardiothoracic: Rigid bronchoscopy

### ☞ Signs of tube obstruction:

- ↓ tidal volume
- ↑ peak airway pressure
- ↑ work of breathing
- قسطرة التشفيط مبتعديش للآخر



**Armored ETT are used in:** extensive movement, shared airway & abnormal position.

**Nasal ETT fixation length:** 3-5 cm more than Oral ETT.

### **Types of Endotracheal Tubes:**

- According to material: PVC, Rubber, Metal.
- According to insertion: Nasal, Oral, Submental.
- According to cuff: Cuffed, Uncuffed.
- According to lumen: Single, Double.

### **Intubation in full stomach:**

- Rapid sequence induction.
- Awake fiberoptic intubation or awake tracheostomy.

### **Intubation in difficult airway:**

- Inhalational induction.
- Awake fiberoptic intubation.

### **Intubation in full stomach with difficult airway:**

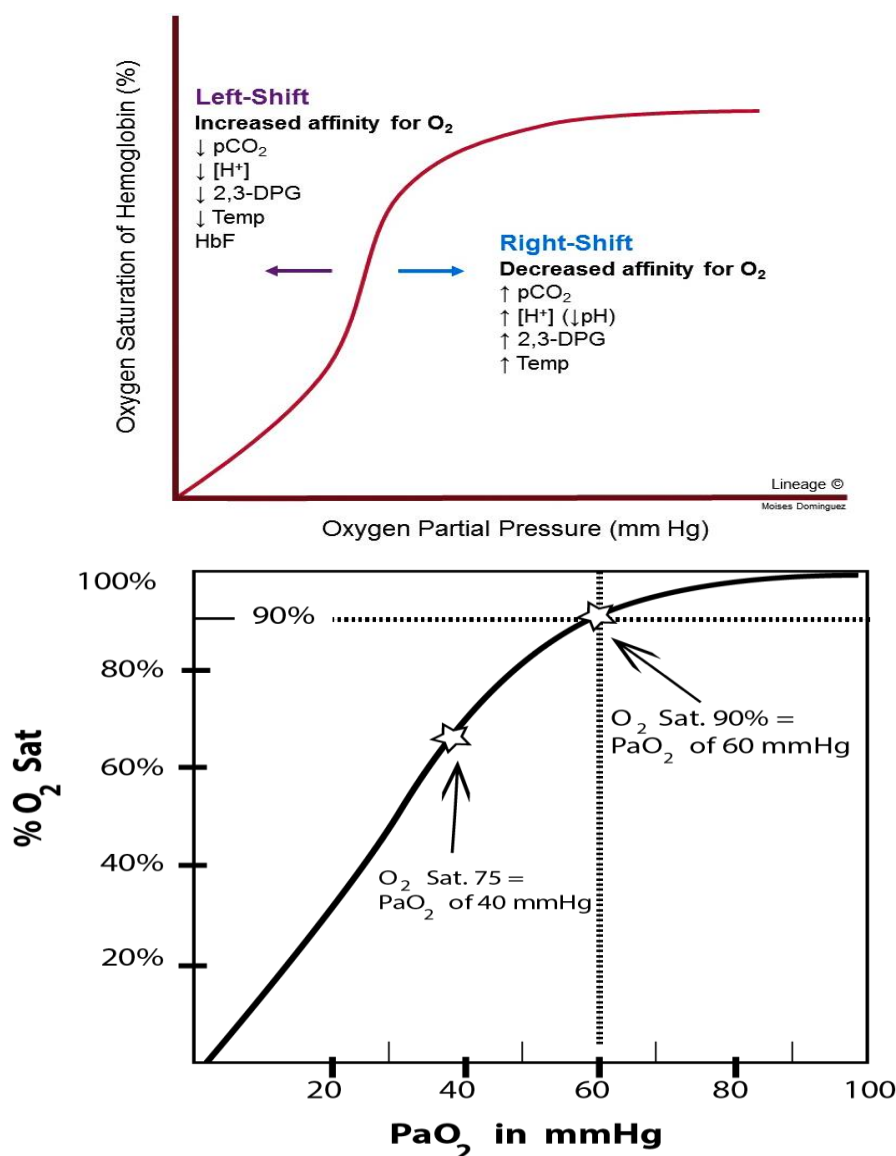
- Awake fiberoptic intubation or awake tracheostomy.



## Specific precautions for intubated pediatrics (small ETT)

- Suction every 2 hours بنفسك
- Humidifier ملين و شغال
- Bronchodilators
- Saline nebulizer
- Solucortef
- لو قلقان منه حطه على VCV وارفع الـ pmax خليه 100 لأن أي شوية secretions هيسدوا الأنبوبة ومش هيتفنتل .
- Tracheostomy: wash twice per day after day 6 .

## Oxy-hemoglobin dissociation curve



- ♦ PO<sub>2</sub>: 27 → SO<sub>2</sub>: 50% (P50) = Arterial PO<sub>2</sub> at which 50% of Hb is oxygenated.
- ♦ PO<sub>2</sub>: 40 → SO<sub>2</sub>: 70-75% = Mixed venous tension.
- ♦ PO<sub>2</sub>: 60 → SO<sub>2</sub>: 90% = Least accepted SO<sub>2</sub> for discharge.
- ♦ PO<sub>2</sub>: 100 → SO<sub>2</sub>: 97% = Arterial point.

- ☞ If you set the FiO<sub>2</sub> on 0.4 → SPO<sub>2</sub> is still ≥ 90% → PO<sub>2</sub> is > 60 → PF ratio is > 150 (60/0.4) without ABG sampling.
- ☞ If you set the FiO<sub>2</sub> on 0.3 → SPO<sub>2</sub> is still ≥ 90% → PO<sub>2</sub> is > 60 → PF ratio is > 200 (60/0.3) without ABG sampling.

## Ventilator Graphics

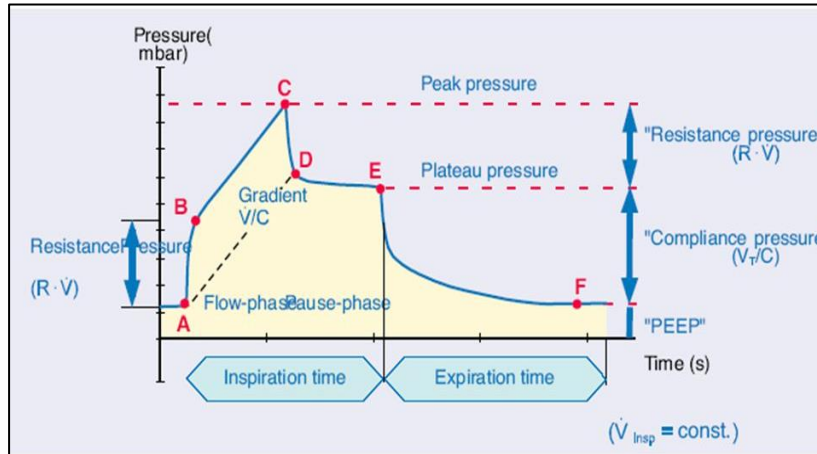
**Curves:** Pressure, flow & volume against time.

**Loops:** Flow-volume & pressure-volume loops (data interpretation).

### Curves

#### 1. Pressure-time curve

##### a) Volume controlled ventilation:



- ♦ **A → B:** **Resistance of the airway** to air flow, so pressure increases dramatically since airways are unable to distend.  
This pressure is present during air flow & absent during the inspiratory pause.
- ♦ **B → C:** Pressure created by **lung elastance** (1/compliance). Pressure increases gradually since lung parenchyma is able to distend.
- ♦ **At point C:** No further flow as the ventilator delivered the set tidal volume, so pressure quickly falls to plateau pressure, the degree of fall equals the rise of pressure caused by the resistance at the beginning of inspiration... i.e.  $A \rightarrow B = C \rightarrow D = \text{resistance pressure}$ .
- ♦ **At point E:** Termination of inspiratory time, opening of expiratory valve & drop of pressure down to PEEP occurs.

☞ **Point C** refers to **Peak pressure** = PEEP + V/C + Airway pressure

$$\text{Compliance} = \frac{\Delta \text{volume}}{\Delta \text{pressure}} \rightarrow \Delta \text{Pressure} = \frac{\Delta \text{volume}}{\text{compliance}} \rightarrow \Delta \text{Pressure} = \frac{\text{Tidal volume}}{\text{compliance}}$$

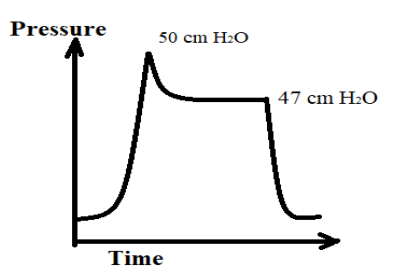
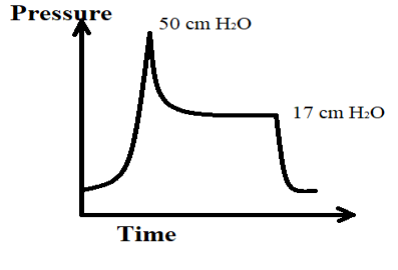
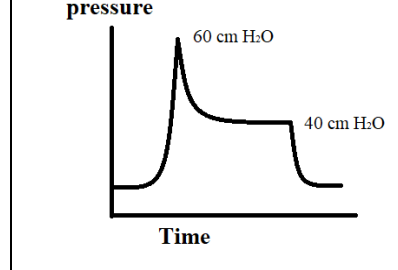
$$\Delta \text{Pressure} = \text{Plateau} - \text{PEEP}, \Delta \text{Volume} = \text{Tidal volume} \rightarrow \text{Pressure} = V/C$$

$$\text{Pressure} = \text{Resistance} \times \text{Flow} \dots \text{e.g., MAP} = \text{SVR} \times \text{COP}$$

$$\text{Airway pressure} = \text{Airway Resistance (R)} \times \text{Flow (F)}$$

$$\text{So: Peak pressure} = \text{PEEP} + \frac{V}{C} + RF$$

☞ Normally: Peak pressure - Plateau pressure =  $\leq 4 \text{ cmH}_2\text{O}$

Lung compliance disease	Resistance problem	Combined
		
$PEEP + \frac{\uparrow V}{\downarrow C} + RF$ $\uparrow$ Tidal volume or $\downarrow$ Lung compliance $\rightarrow \uparrow$ both peak & plateau pressures equally.	$PEEP + \frac{V}{C} + \uparrow RF$ $\uparrow$ Airway resistance or $\uparrow$ flow (by decreasing inspiratory time) $\rightarrow \uparrow$ peak pressure only.	$PEEP + \frac{V}{\downarrow C} + \uparrow RF$ $\downarrow$ Lung compliance + $\uparrow$ Airway resistance $\rightarrow \uparrow$ both pressures. Rise of peak pressure is more than that of plateau pressure.

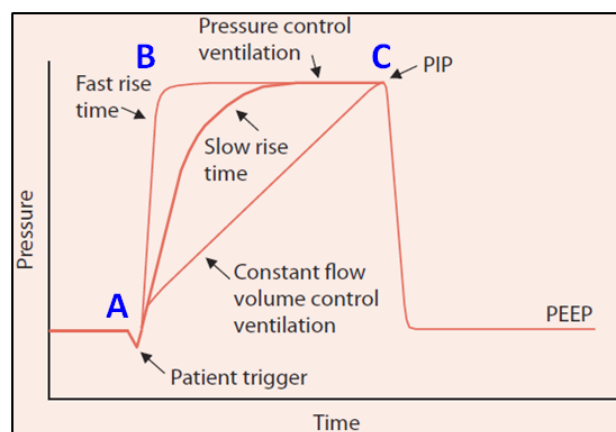
➤ Static compliance =  $\Delta V / \Delta P \rightarrow TV / (\text{Plateau pressure} - PEEP)$

➤ Dynamic compliance =  $\Delta V / \Delta P \rightarrow TV / (\text{Peak pressure} - PEEP)$

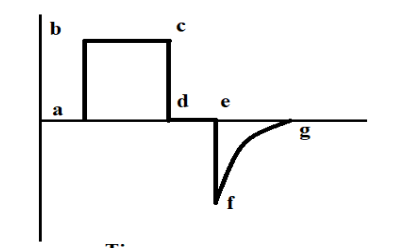
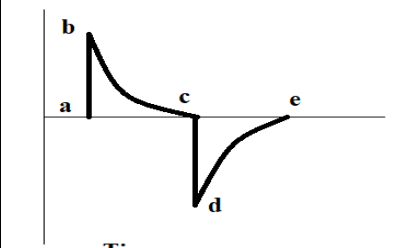
	ICU ventilator	Anesthesia machine
Flow	Very high flow. No recycling of gases.	Low flow with recycling to preserve inhalational anesthetics & oxygen. Fresh gas flow can be reduced down to 250 ml/min (average O <sub>2</sub> consumption in adults) provided that no leak in the circuit.
CO <sub>2</sub> absorber	Absent	Present to get rid of CO <sub>2</sub> & thus, allow recycling of expired anesthetic gases.

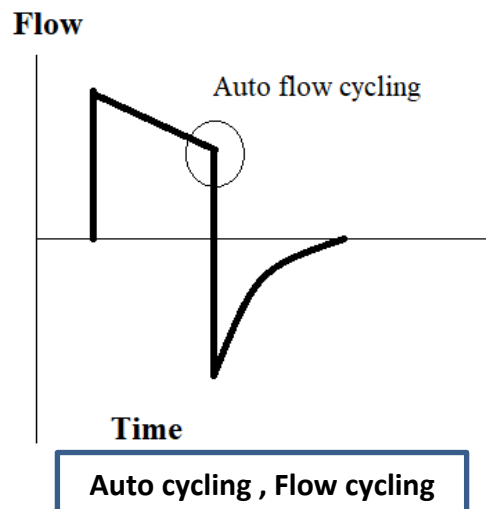
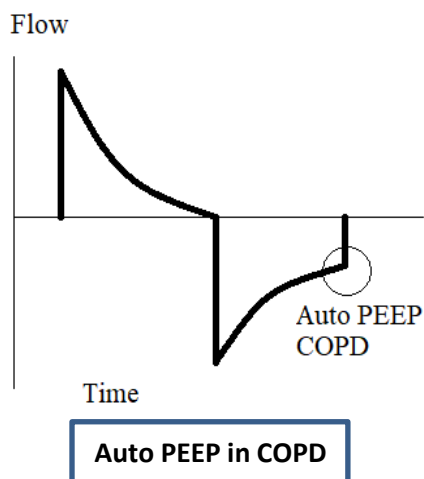
## b) Pressure controlled ventilation

- At first, the ventilator delivers a volume to reach target pressure, so **from A to B** there is a sharp rise in pressure.
- Point B:** Inspiratory pressure.
- From B → C:** It is not a pause!! but the pressure doesn't rise or fall due to decelerating flow to maintain pressure inside the lung constant during inspiratory time.
- At point C:** the expiratory valve opens & the pressure falls to PEEP and expiration begins.



## 2. Flow time curve

Volume controlled ventilation	Pressure controlled ventilation
<ul style="list-style-type: none"> <li>The flow during inspiration is constant.</li> <li>From D → E it is inspiratory pause.</li> <li>The flow during expiration is decelerating flow (passive expiration).</li> </ul>	<ul style="list-style-type: none"> <li>The flow during inspiration is decelerating.</li> <li>The flow during expiration is decelerating flow (passive expiration).</li> </ul>
	



### 3. Volume time curve

Volume controlled ventilation	Pressure controlled ventilation
<ul style="list-style-type: none"> <li>♦ The flow during inspiration is constant flow .</li> <li>♦ From D ---- E it is inspiratory pause .</li> <li>♦ The flow during expiration is decelerating flow (passive expiration).</li> </ul>	<ul style="list-style-type: none"> <li>♦ The flow during inspiration is decelerating flow .</li> <li>♦ The flow during expiration is decelerating flow (passive expiration).</li> <li>♦ Accelerating flow.</li> </ul>
<p>Volume</p> <p>Inspiratory time</p> <p>Expiratory time</p>	<p>Volume</p> <p>Insp. time</p> <p>Exp time</p> <p>Time</p>

## **Mechanical ventilation**

### **Classification :**

Positive pressure vs negative pressure ventilation:

#### **1. Negative pressure ventilators :**

Iron Lung: pastly used in the era of poliomyelitis & recently in patients with neuromuscular disorders.  
Disadvantages: Patient handling, Patient discomfort, No airway protection .

#### **2. Positive pressure ventilation**

Gas is forced into the patient lung by mechanical means .

This can be : invasive → ETT or non-invasive → CPAP mask ( Face or Nasal )

### **Volume targeted VS Pressure limited ventilation**

	Volume targeted ventilation	Pressure limited ventilation
<b>Pressure</b>	P. Peak P. Plateau	P. Plateau
<b>Flow</b>	Constant flow	Variable decelerating
<b>Advantages</b>	Guarantee ventilation	Limiting pressure Flow pattern allows better ventilation Patient satisfaction.
<b>Disadvantages</b>	Allows pressure to increase	Cannot guarantee ventilation

Types of breaths:

1. Mandatory
2. Assisted
3. Spontaneous

Trigger:

1. Patient
2. Time (machine)

Limit (target)

1. Pressure
2. Volume

Cycling (end of inspiration)

1. Time
2. Flow

### **Components of mechanical breath :**

#### **1. Trigger :**

- By mechanical ventilator : time triggering .
- By the patient :

Type	Flow triggering	Pressure triggering
Level	2 L/min	-2 cmH <sub>2</sub> O
Mechanics	Inspiratory valve partially closed	Inspiratory valve completely closed

- Effect of high level triggering ----- fighting of the ventilator
- Effect of low level triggering ----- Auto triggering .

#### **2. Limit :**

- Volume in volume targeted ventilation .
- Pressure in pressure targeted ventilation .

### **3. Cycling: shift from expiration to inspiration**

- I:E ratio (inspiratory time): time based.
- Flow cycling: in spontaneous mode, when flow reaches 25% of the initial flow (CPAP, SIMV, BIPAP).

### **Ventilator parameters**

1. Tidal volume (TV): volume modes and pressure controlled volume guaranteed.
2. Inspiratory pressure (P<sub>insp</sub>): pressure modes .
3. Respiratory rate (RR).
4. Fraction of inspired oxygen (FiO<sub>2</sub>).
5. I:E ratio.
6. Trigger (in assist control or spontaneous modes).
7. P max (P limit) .

### **Modes of mechanical ventilation**

#### **Based on triggering :**

- Controlled ventilation ----- only time triggering.
- Assist control ventilation ----- time ± flow or pressure triggering.

#### **Pressure or volume modes.**

	Trigger	Limit	cycling	TV	PS	P <sub>insp</sub>	RR	I:E	PEEP	P <sub>max</sub>	FiO <sub>2</sub>
VCV	Time	Volume	Time	√	—	—	√	√	√	√	√
aVCV	Time ±flow or Press	Volume	Time	√	—	—	√	√	√	√	√
SIMV-VC	Time ±flow or Press	V±P	Time ± Flow	√	√	—	√	√	√	√	√
PCV	Time	Press	Time	—	—	√	√	√	√	—	√
aPCV	Time ±flow or Press	Press	Time	—	—	√	√	√	√	—	√
SIMV-PC	Time ±flow or Press	Press	Time ± Flow	—	√	√	√	√	√	—	√
PCVG	Time ±flow or Press	P±V	Time	√	—	—	√	√	√	—	√
BiPAP	Time ±flow or Press	Press	Time ± Flow	—	√	√	√	√	√	—	√
APRV	Time ±flow or Press	Press	Time ± Flow	—	√	√	√	√	√	—	√
CPAP	Flow or Press	Press	Flow	—	√	—	—	—	√	—	√

## Oxygen cascade

### **Dalton's law of partial pressure :**

The total pressure of a mixture of gases is equal to the sum of the partial pressure of the individual constituent gases. i.e,  $P_{\text{total}} = P_1 + P_2 + P_3$

### **Clinical application**

Ambient air pressure =  $P_{O_2} + P_{N_2} + P_{\text{water vapour}}$

So  $P_{O_2} = (\text{ambient air pressure} - \text{saturated vapour pressure}) \times 21/100 = (760 - 50) \times 21/100 = 150 \text{ mmHg}$

$P_{N_2} = 710 \times 80/100 = 600 \text{ mmHg}$

- ①  $P_{O_2}$  in the trachea = 150 mmHg

Pressure of oxygen in the alveoli =  $150 - (P_{CO_2} / \text{respiratory quotient})$

While  $P_{CO_2} = 35 \text{ mmHg}$

$RQ = CO_2 \text{ production} / O_2 \text{ consumption} = 200/250 = 0.8$

So,  $P_{aO_2} = 150 - 35/0.8 = 110 \text{ mmHg}$

N.B - Carbs increases  $CO_2$  production -----  $RQ = 1$

- Ptns decreases  $CO_2$  production -----  $RQ = 0.7$

- Increase  $CO_2$  ----- decreases alveolar  $O_2$  tension ----- decreases saturation

- ② Pulmonary end capillary  $O_2$  tension :

In practice, it is considered to be  $P_{aO_2}$  provided ACM is normal

Arterial  $O_2$  tension:  $P_{aO_2} = 102 - \text{age}/3$

N.B 110-----102 How?

1. Basal atelectasis which increase with age .
2. Bronchial drainage .
3. Thebesian veins (venous drainage of the heart).
4. Shunting .

- ③ Mixed venous  $O_2$  tension ----- 40 mmHg .

N.B, Mixed venous  $SO_2 = 70-75\%$  (pulmonary artery).

Central venous  $SO_2 = 65-70\%$  (superior vena cava only).

In anesthetised patient :

Mixed venous  $> 70\%$                       Central venous  $> 65\%$

Because anesthetised patients have low cerebral metabolic rate.

Expected arterial  $O_2$  tension ( $P_{aO_2}$ ) =  $F_{iO_2} \times 5$

e.g if  $F_{iO_2}$  is 40%  $\rightarrow$  so  $P_{aO_2} = 40 \times 5 = 200 \text{ mmHg}$

## ***Hypoxic pulmonary vasoconstriction (HPV)***

Alveoli filled with secretion →→ vasoconstriction.

- Direct blood flow to better oxygenated parts of the lung .
- The major stimulus is alveolar hypoxia, so increasing the  $\text{FiO}_2$  →→ blunting of HPV →→  
↓↓ arterial  $\text{O}_2$  tension.
- Every 10% increase above  $\text{FiO}_2$  40% →→ ↓↓ expected arterial  $\text{O}_2$  tension by 5-10 mmHg.  
e.g : 100% ----- 6 times increases by 10% above 40%

- Functional residual capacity = Residual volume + Expiratory Reserve Volume = 2500 ml
- Preoxygenation allows 10 minutes before desaturation as  $\text{O}_2$  consumption is 250ml / min
- Average rise of  $\text{CO}_2$  in 1<sup>st</sup> minute is 6 mmHg, then 4 mmHg every minute after.
- $\text{CO}_2$  after 10 minutes = 42 mmHg + already existing 30 = 72 mmHg.



# ARDS

## Definition

Acute persistent hypoxia with bilateral diffuse lung infiltrate due to non-cardiogenic etiology.

1. Acute → within 7 days from the triggering factor, commonly in the first 3 days.

2. Persistent hypoxia →  $PO_2/FiO_2 \rightarrow < 300$ .

Mild: 200-300

Moderate: 100-200

Severe:  $< 100$

3. Bilateral diffuse lung infiltrates in CXR.

4. Non-cardiogenic etiology → (Echo + brain natri-uretic peptide ).

± 5. Cause

## Etiology

### a) Pulmonary

♦ Aspiration & pneumonia

### b) Extra-pulmonary

♦ Sepsis & Trauma → the most common.

♦ Pancreatitis, purpura, burn, blood component transfusion (blood, plasma, platelets).

♦ Cardiopulmonary bypass

♦ Drugs: Oxygen, cocaine, heroin.

♦ Embolism: Fat, amniotic, repetitive minor venous emboli from DVT.

## Differential diagnosis of hypoxia

### 1. Chest auscultation:

★ Diminished unilateral: collapse - endobronchial tube - هواء - ميه - دم

★ Diminished bilateral: pleural effusion → treated by PEEP + lasix + cause.

### 2. Imaging:

♦ CXR or CT chest → pneumonia, pneumothorax, ARDS, endobronchial tube ± Lung ultrasound.

♦ Lung ultrasound → pneumothorax .

### 3. Echo:

♦ Right side: Dilated in case of pulmonary embolism.

♦ Left side: Poor contractility is suggestive of heart failure & pulmonary edema.

### 4. Numerics of ventilator:

♦ Check peak airway pressure, plateau pressure & tidal volume.

- ↑ peak & plateau → ↓↓ compliance.

- ↑ peak & normal plateau → obstruction.

➤ Pleural effusion → chest tube ركب → 6 ساعات سم واقفلها 500 → to avoid negative pressure pulmonary edema + Lasix.

➤ Any hemothorax is an indication for chest tube as it doesn't resolve with diuretics.

## Clinical picture

♦ Clinical picture of the cause.

♦ Rapidly progressive respiratory distress (dyspnea & tachypnea).

♦ Early: hypoxia, late: hypercarbia.

♦ ABG → acute severe hypoxemia.

♦ PFTs → restrictive pattern.

♦ CXR → bilateral diffuse infiltration.

♦ Complications → DIC, ventricular arrhythmia or AKI.

## Prognosis

- Mortality: 30% either due to the primary cause or due to complications (MOSF).

## Management

- 1) **ABC** (control of BP and saturation within 30 minutes with adequate blood gases and ventilator parameters).
- 2) **Definitive treatment.**
- 3) **Treatment of cause.**
- 4) **Treatment of complications.**

## Definitive treatment

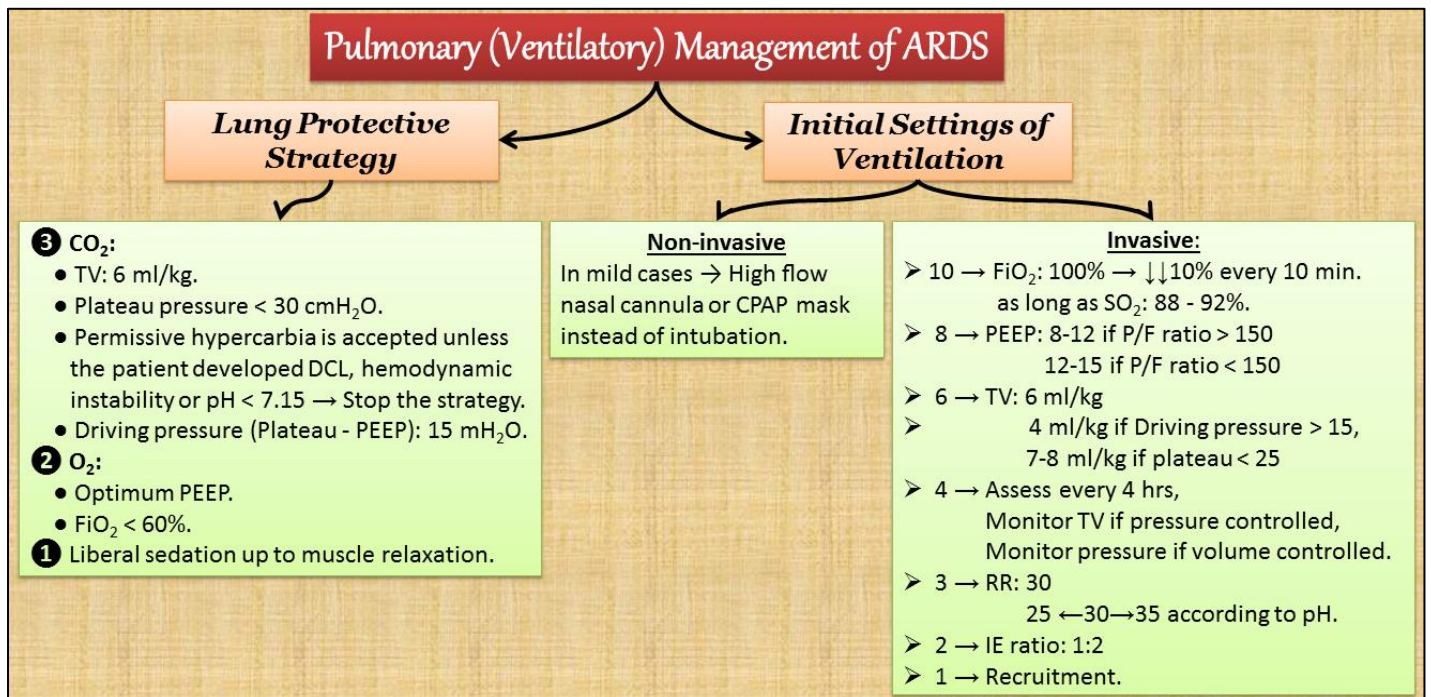
### a) Extra-pulmonary

1. **Solumedrol** →→ Given in case of PF ratio < 150  
1 mg/kg/day for 5-7 days or IV infusion ... Then 0.5 mg/kg/day for 5-7 days  
Then 0.25 mg/kg/day for 5-7 days... Then 0.125 mg/kg/day for 3 days.
2. **Liberal sedation up to muscle relaxation (tracium)** for 48 hours (within 24-48 hours from the onset of ARDS. Performed only if P/F ratio < 150.
3. **Negative balance using diuretics.**
4. **Nitric oxide inhalation:** Selective pulmonary VD i.e. to ventilated alveoli, so shifts blood from non-ventilated alveoli to ventilated ones.  
Rapidly metabolized → so it acts on lungs only and doesn't reach systemic circulation.
5. **Extra-corporeal membrane oxygenation (ECMO).**
6. **Prone position** for 16 hours daily for 3 days → Only if P/F ratio < 150.  
The main bulk of the lungs lies posteriorly → So, prone position provides better ventilation to larger portions of the lungs.

### b) Pulmonary

- Non-invasive: in mild cases.
- Invasive (intubation): in severe hypoxemia.

📖 Ventilator-induced lung injury in ARDS: volutrauma, barotrauma, atelectrauma, biotrauma & oxygen toxicity → avoided by lung protective strategy.



Recruitment	
<b>Indications</b>	Severe ARDS: P/F ratio < 150 ... Done in the first 3 days.
<b>Contraindications</b>	<ul style="list-style-type: none"> <li>- Chest tube (pneumothorax)</li> <li>- Broncho-pleural fistula</li> <li>- Late ARDS &gt; 5 days</li> <li>- Cardiac patient (hemodynamic instability)</li> <li>- Failure of previous recruitment</li> </ul>
<b>Preparation</b>	<ul style="list-style-type: none"> <li>- Arterial line + baseline ABG.</li> <li>- FiO<sub>2</sub>: 100%.</li> <li>- Deep sedation &amp; relaxation.</li> <li>- Normalize BP: If borderline → Give fluids if fluid responder → Inotropes (minimal dose) if non-responder</li> </ul>
<b>Pre-test</b>	PEEP 15-20 for 15 minutes. Look at PO <sub>2</sub> , SO <sub>2</sub> , P/F ratio & oxygenation index. If > ↑↑ 5% → Recrutable.
<b>Methods</b>	<ul style="list-style-type: none"> <li>♦ PEEP 40 for 40 seconds → بطلت بس بنستخدمها في العمليات</li> <li>♦ Driving pressure 15 cmH<sub>2</sub>O ... 8 minutes divided into 4 steps.</li> </ul>
<b>Complications</b>	<ul style="list-style-type: none"> <li>- Pneumothorax</li> <li>- Hemodynamic instability</li> </ul>

Duration	Driving pressure	I:E ratio	RR	FiO <sub>2</sub>	PEEP
2 minutes	15	1 : 1	10	1	20
2 minutes	15	1 : 1	10	1	25
2 minutes	15	1 : 1	10	1	30
2 minutes	15	1 : 1	10	1	20

♦ Then: ABG → If PO<sub>2</sub> + PCO<sub>2</sub> > 400 → This means that 95% of alveoli are opened.

♦ Calculate the optimum PEEP:

انزل بالـ PEEP بمقدار 2 لمدة 3-5 دقائق واسحب ABG وشوف الـ PO<sub>2</sub> ← لو قل بمقدار أقل من 10% ← انزل بالـ PEEP  
 كمان 2 لمدة 3-5 دقائق وعيد الـ ABG ← لو الـ PO<sub>2</sub> قل بمقدار أكثر من 10% من اللي قبله يبقى ده الـ Closing pressure  
 اعلى فوقه بـ 2 وثبت على كده وهو ده الـ Optimum PEEP وليكن مثلاً 16 ... بعد كده عيد الأربع خطوات ثاني وآخر PEEP في  
 الخطوة الرابعة يبقى 16 مش 20.

♦ Then: Reset the ventilator parameters back to ARDS ones.

PEEP: 16 (optimum PEEP),

I:E ratio 1:2

RR:30

TV: 6 ml/kg

FiO<sub>2</sub>: the least achieving SO<sub>2</sub> > 88%

Plateau pressure: < 30 cmH<sub>2</sub>O

♦ Then: Keep the patient on the optimum PEEP till FiO<sub>2</sub> can be decreased to 40% with SO<sub>2</sub> > 88% → then PEEP can be decreased together with solumedrol & negative balance.

♦ If ABG from the start showed that PO<sub>2</sub> + PCO<sub>2</sub> < 400 → Repeat recruitment steps for 3 times → If failed → Not recruitable → for prone position.

# OXYGEN THERAPY

## Nasal cannula

- Adjust to 0.5-6 L/min to avoid nasal dryness.
- Gives  $\text{FiO}_2$  24 - 40%.
- Advantages: can talk & eat.

## High flow nasal cannula (+ humidifier)

- Adjust to 20-100 L/min.
- Gives  $\text{FiO}_2$  21 - 100%.
- For every 10 L/min of flow  $\rightarrow$  1.3 cmH<sub>2</sub>O PEEP is delivered.  
40 L/min  $\rightarrow$  PEEP 5 ... 60 L/min  $\rightarrow$  PEEP 8.
- Indications:
  - Alternative to CPAP mask with better patient compliance in pulmonary edema & COPD.
  - Chest trauma.

## Oxygen Mask

### 1. Open mask

- When set at 6 L/min it gives  $\text{FiO}_2$  24%.
- Every additional 1 L/min  $\rightarrow$   $\uparrow$   $\text{FiO}_2$  by 3%.

### 2. Venturi mask

- Up to  $\text{FiO}_2$  60%.
  - Each color is labelled for X L/min gives Y  $\text{FiO}_2$
- الماسك بيوصل علي جزء ملون، كل لون ببيقي مكتوب علي يتضبط علي كام لتر فيديك كام أكسجين .

### 3. Non rebreathing Mask with reservoir bag

- Gives  $\text{FiO}_2$  80 - 100%.

## CPAP mask

- Indications:
  - COPD
  - Acute pulmonary edema
  - Early ARDS
  - Obstructive sleep apnea

# BLOOD GASES

## pH "power of hydrogen"

- It is the negative log of  $H^+$  ions to the power 10 .
- Why to the power of 10? → because  $H^+$  concentration = 40 nano Eq/L "small number so, power of 10 → readable
- **Negative** means that pH values get lower as the  $H^+$  ions concentration increases.
- **Logarithmic** means that shift of pH by 1 represents a 10 fold change in  $H^+$  ions concentration e.g, 7 is 10 times more acidic than 8.

## Normal values

PH: 7.36 - 7.44

PCO<sub>2</sub>: 36 - 44 mmHg

PO<sub>2</sub>:  $102 - (\frac{Age}{3})$

HCO<sub>3</sub><sup>-</sup>: 22 - 26 mEq/L

Lactate: < 2 mEq/L

Chloride: 95-105 mEq/L

Anion gap: 12-18 mEq

Death occurs at pH less than 6.8 or more than 7.8 due to enzymatic dysfunction.

## Compensatory mechanisms

### 1. Buffers

- HCO<sub>3</sub><sup>-</sup> pka: 6.1 + 1 → so it is more effective at pH less than 7.1 .
- Hemoglobin
- Proteins
- Others.

### 2. Respiratory

- Takes one hour from metabolic acidosis "tachypnea".
- Takes one hour from metabolic alkalosis "bradypnea".
- Respiratory compensation is more effective in metabolic acidosis.
- In case of bradypnea → ↑CO<sub>2</sub> & ↓O<sub>2</sub> → stimulate breathing.
- ↑PCO<sub>2</sub> by 1 mmHg → ↑ minute ventilation by 1 liter.

### 3. Renal

- Takes one day to start with maximum effect after 3 days.
- It includes :
  - ☞ Reabsorption of HCO<sub>3</sub><sup>-</sup>
  - ☞ Excretion of titratable acids
  - ☞ Formation of ammonia

## Components of blood gases

1. Oxygenation & Ventilation
2. Metabolic component
3. Electrolytes & Hb "if calibrated"
4. Anion gap
5. Glucose
6. Lactate

☞ كل item في ABG بيكلف حوالي 50 جنيه في البرايفت ... لو سحبت ABG كاملة بتكلف حوالي 500 جنيه !!!  
فمتعملش أكثر من واحدة للعيان إلا لو في indication .

أي عيان **obese** :

1. لما يصحى قعده 90° وحطه oxygen mask وقوله يكح .
2. لو الـ PF ratio مش كويس اعمله recruitment .

## Compensation

<b>Respiratory</b>	Metabolic acidosis: Expected $\downarrow \text{CO}_2 \rightarrow 1.2 \times \Delta \text{HCO}_3^-$ Metabolic alkalosis: Expected $\downarrow \text{CO}_2 \rightarrow 0.7 \times \Delta \text{HCO}_3^-$
<b>Metabolic</b>	Respiratory acidosis : Expected $\uparrow \text{HCO}_3^-$ : Acute: 1 for each 10 mmHg increase in $\text{CO}_2$ . Chronic: 4 for each 10 mmHg increase in $\text{CO}_2$ . Respiratory alkalosis : Expected $\downarrow \text{HCO}_3^-$ : Acute: 2 for each 10 mmHg increase in $\text{CO}_2$ . Chronic: 5 for each 10 mmHg increase in $\text{CO}_2$ .

## Effects of acid-base disturbance on different organs

	Acidosis	Alkalosis
<b>CNS</b>	- Cerebral vasodilatation. - CNS depression .	Cerebral vasoconstriction. CNS excitation .
<b>Respiratory</b>	- Bronchodilatation. - Shift of oxyhemoglobin dissociation curve to the right. - Vasoconstriction of bronchial vessels . - Respiratory center stimulation.	- Bronchoconstriction. - Shift of oxy-hemoglobin dissociation curve to the left. - Vasodilatation of bronchial vessels. - Respiratory center depression .
<b>CVS</b>	- $\text{PCO}_2$ : 60-80 $\rightarrow$ stimulation $\text{PCO}_2$ : > 80 $\rightarrow$ depression Early $\rightarrow$ stimulation occurs due to release of catecholamines. Late $\rightarrow$ depression occurs due to myocardial depression, vasomotor center inhibition and vasodilatation.	- Arrhythmias due to hypokalemia & $\downarrow$ ionized calcium.
<b>Electrolytes</b>	$\uparrow \text{K}^+$ & $\uparrow$ ionized calcium. $\downarrow$ pH by 0.1 $\rightarrow$ $\uparrow$ serum $\text{K}^+$ by 0.6 mEq/L.	$\downarrow \text{K}^+$ & $\downarrow$ ionized calcium.

## Diagnosis of acid base disturbance $\rightarrow$ See the algorithm.

- Treatment**
1. ABC including re-adjustment of ventilation parameters in ventilated patients.
  2. Treatment of the cause.
  3. Specific treatment: e.g,  $\text{NaHCO}_3$  & dialysis in severe metabolic acidosis.

## Metabolic acidosis

- $\downarrow \text{pH}$ ,  $\downarrow \text{PCO}_2$ ,  $\downarrow \text{HCO}_3^-$
- Respiratory compensation ( $\Delta \text{PCO}_2$ ) =  $1.2 \times \Delta \text{HCO}_3^-$
- If the cause of acidosis is unclear  $\rightarrow$  calculate the anion gap,

### Anion gap

- Used to determine if metabolic acidosis is due to accumulation of acids (high anion gap) as in DKA or loss of bicarb (normal anion gap) as in diarrhea.
- To achieve electrochemical balance, the concentration of negatively charged anions must equal the concentration of positively charged cations:

$$\text{Na} + \text{UC} = (\text{Cl} + \text{HCO}_3) + \text{UA} \rightarrow \rightarrow \rightarrow \text{Na} - (\text{Cl} + \text{HCO}_3) = \text{UA} - \text{UC}$$

$\text{UA} - \text{UC}$  is the anion gap (AG) and =  $\text{Na} - (\text{Cl} + \text{HCO}_3)$



- Unmeasured anions = 23 mEq/L: Albumin(15), Organic acids(5), Phosphate(2) & Sulphate(1)
- Unmeasured cations = 11 mEq/L: Calcium(5), Potassium(4.5) & Magnesium(1.5)
- Normal AG = 23 - 11 = 12 ± 4.
- ↓ Albumin by 1 gm/dl → ↓ anion gap by 2.5 → this could mask the presence of excess unmeasured anion (e.g., lactate) contributing to metabolic acidosis → So: calculate the corrected AG →→→ Corrected AG = AG + [2.5 × (4.5 – albumin in g/dL)].

### Gap-gap Ratio:

- AG Excess/HCO<sub>3</sub> Deficit =  $\frac{AG-12}{24-HCO_3}$
- If metabolic acidosis is due to excess acids only (high AG) → the increase of AG will be equivalent to the decrease of HCO<sub>3</sub> → So, the Gap-Gap ratio will be 1.
- If metabolic acidosis is due to excess acids plus loss of bicarb (high & normal AG)→the decrease in HCO<sub>3</sub> will be greater than the increase in AG → the gap-gap ratio will be < 1.
- In case of co-existence of high AG metabolic acidosis with metabolic alkalosis (nasogastric drainage or diuretics) → the decrease in HCO<sub>3</sub> will be less than the increase in AG→ the gap-gap ratio will be > 1.

### ➤ Types of metabolic acidosis:

**1. High anion gap metabolic acidosis:** It occurs as a result of excess acids:

- ♦ **Exogenous:** methanol, ethanol & salicylates (late).
- ♦ **Endogenous:** ☞ **Increased production:** ketoacidosis (DKA), lactic acidosis (sepsis, metformin, starvation & hypoperfusion).
- ☞ **Decreased excretion:** acute & chronic renal failure.

The Most common cause is renal impairment.

### **2. Normal anion gap metabolic acidosis (Hyperchloremic metabolic acidosis):**

It occurs as a result of loss of bicarb which is balanced by increased renal reabsorption of chloride ions to maintain electrical charge neutrality.

- ☞ **Causes:** Uretero-enterostomy, ileal conduit (absorption of chloride from urine)
- أكل خارج → Ileostomy, pancreatic fistula & diarrhea,
- أكل داخل → TPN: panamin contains high chloride content,
- ميه داخلية → Infusion of large volume of saline,
- ميه خارجة → Carbonic anhydrase inhibitor (Acetazolamide)
- & Renal tubular acidosis.

N.B, Acetazolamide causes acidosis + ↓K<sup>+</sup> الوحيد

➤ **Clinical picture:** clinical picture of the cause + effects of acidosis on different organs.

➤ **Treatment:**

1. ABC.
2. Treatment of the cause
3. If  $\text{pH} < 7.1 \rightarrow$  correct  $\text{HCO}_3^-$ :  $\frac{1}{3}$  deficit x body weight  $\rightarrow$  then half correction  
Or  $\frac{1}{3}$  base excess x body weight.

★ **Base excess:**

- Amount of acid or alkali to be added to blood at temperature  $37^\circ\text{C}$  & normal oxygen saturation to normalize the pH.
- If -ve  $\rightarrow$  acidosis, if +ve  $\rightarrow$  alkalosis
- Normally it is - 2 to + 2 mEq/L
- Metabolic alkalosis  $> +2$ , Metabolic acidosis  $< -2$

★ **Dose of  $\text{HCO}_3^-$  in pediatrics**  $\rightarrow$  1-2 mEq/kg.

★ **Wait before giving  $\text{HCO}_3^-$ :**

- Mild acidosis is useful  $\rightarrow$  effect on organs.
- $\text{NaHCO}_3$ : in neonates  $\rightarrow$  hypernatremia & ICH.  
in adults  $\rightarrow \uparrow\text{CO}_2 \rightarrow$  delay the weaning & intracellular acidosis.
- Give  $\text{NaHCO}_3$  when pH is  $< 7.1$  .... or  $< 7$  in DKA as it responds rapidly to fluids & insulin.
- If renal cause  $\rightarrow$  dialysis is indicated.

N.B: Carbicarb  $\rightarrow$  has no side effects but not present in Egypt.

## Metabolic alkalosis

- $\uparrow\text{pH}$ ,  $\uparrow\text{PCO}_2$ ,  $\uparrow\text{HCO}_3^-$
- Respiratory compensation ( $\Delta \text{PCO}_2$ ) =  $0.7 \times \Delta \text{HCO}_3^-$
- **Causes:**

Chloride Sensitive "Urine chloride $< 15$ mEq/L"	Chloride Resistant "Urine chloride $> 20$ mEq/L"	Miscellaneous
Diuretics Pancreatic fistula Vomiting & nasogastric drainage Chloride diarrhea	البوتاسيوم وهرموناته - Hypokalemia - Conn's & Cushing syndromes	Bicarbonate Milk alkali syndrome

**N.B:** The most common cause of chronic hypokalemia is hypomagnesemia.

- **Clinical picture:** clinical picture of the cause + effects of alkalosis on different organs.
- **Treatment:**
  1. ABC.
  2. Treatment of the cause.
  3. If chloride sensitive  $\rightarrow \frac{1}{3}$  deficit x body weight.  
If  $\text{pH} > 7.6$  and the patient is not responding to treatment  $\rightarrow$  dialysis.



## Respiratory acidosis

➤ ↓pH, ↑PCO<sub>2</sub>, ↑HCO<sub>3</sub><sup>-</sup>

➤ **Causes:**

### 1. Increased production:

- ◆ Exogenous: CO<sub>2</sub> insufflation -TPN (High CHO content) -Bicarb.
- ◆ Endogenous:
  - ☞ Tourniquet release, malignant hyperthermia (sux), fever
  - Neuroleptic malignant syndrome (anti-psychotic drugs) & thyroid storm.

### 2. Decreased elimination = Hypoventilation.

- ◆ **Obstructive** : Upper airway: foreign body & laryngeal spasm.  
Lower airway: COPD & bronchospasm.

◆ **Restrictive:**

#### Neuromuscular diseases:

- Central: Hemorrhage, tumor, trauma, drugs
- Spinal cord: Trauma
- Ganglion: Poliomyelitis
- Nerve: Neuropathy
- Neuromuscular junction: Myasthenia
- Muscle: Myopathy

#### ↓ Compliance:

- Lung: Interstitial pulmonary fibrosis, pulmonary edema (late)
- Pleura: Pleural effusion, pneumothorax
- Thoracic wall: Kyphoscoliosis
- Soft tissue: Morbid obesity (Pickwickian syndrome)
- ◆ **جهاز بايظ**: CO<sub>2</sub> rebreathing : exhausted soda lime, valve malfunction.
- ◆ **دكتور لا مؤاخذة**: Inadequate ventilation parameters.

لو نيم طفل وبعده حالة adult ونسى يعدل الـ ventilation parameters.

➤ **Clinical picture:** clinical picture of the cause + effects of acidosis on different organs.

➤ **Treatment:**

1. ABC.
2. Treatment of the cause \* COPD → low flow oxygen.

## Respiratory alkalosis

➤ ↑pH, ↓PCO<sub>2</sub>, ↓HCO<sub>3</sub><sup>-</sup>

➤ **Causes:**

Central	Lung	Blood	Miscellaneous
Meningitis Hysterical Salicylates "early" Hemorrhage	Early pulmonary edema Minute pulmonary embolism Early pneumonia Pleurisy	Anemia Sepsis (early) Fever	Ascites Pregnancy Inadequate ventilation parameters

➤ **Clinical picture:** clinical picture of the cause + effects of alkalosis on different organs.

➤ **Treatment:**

1. ABC.
2. Treatment of the cause.

## Interpretation of blood gases

1. Arterial or venous: compare with monitor saturation
2. If arterial → assess the PF ratio
3. pH
4.  $\text{PCO}_2$
5.  $\text{HCO}_3^-$
6. Compensation
7. Anion gap
8. Other: Electrolytes, Hb & lactate.

### 11 Possibilities

#### 1. High pH → alkalosis

- + High  $\text{PCO}_2$  + High  $\text{HCO}_3^-$  → Simple metabolic alkalosis.
- + Normal  $\text{PCO}_2$  + High  $\text{HCO}_3^-$  → Combined metabolic & respiratory alkalosis.
- + Low  $\text{PCO}_2$  + Low  $\text{HCO}_3^-$  → Simple respiratory alkalosis.
- + Low  $\text{PCO}_2$  + Normal or High  $\text{HCO}_3^-$  → Combined respiratory & metabolic alkalosis.

#### 2. Low pH → acidosis

- + High  $\text{PCO}_2$  + High  $\text{HCO}_3^-$  → Simple respiratory acidosis.
- + High  $\text{PCO}_2$  + Normal or Low  $\text{HCO}_3^-$  → Combined respiratory & metabolic acidosis.
- + Normal  $\text{PCO}_2$  + Low  $\text{HCO}_3^-$  → Combined metabolic & respiratory acidosis.
- + Low  $\text{PCO}_2$  + Low  $\text{HCO}_3^-$  → Simple metabolic acidosis.

#### 3. Normal pH


- + Normal  $\text{PCO}_2$  + Normal  $\text{HCO}_3^-$  → Normal blood gases.
- + Low  $\text{PCO}_2$  + Low  $\text{HCO}_3^-$  → Combined respiratory alkalosis & metabolic acidosis.

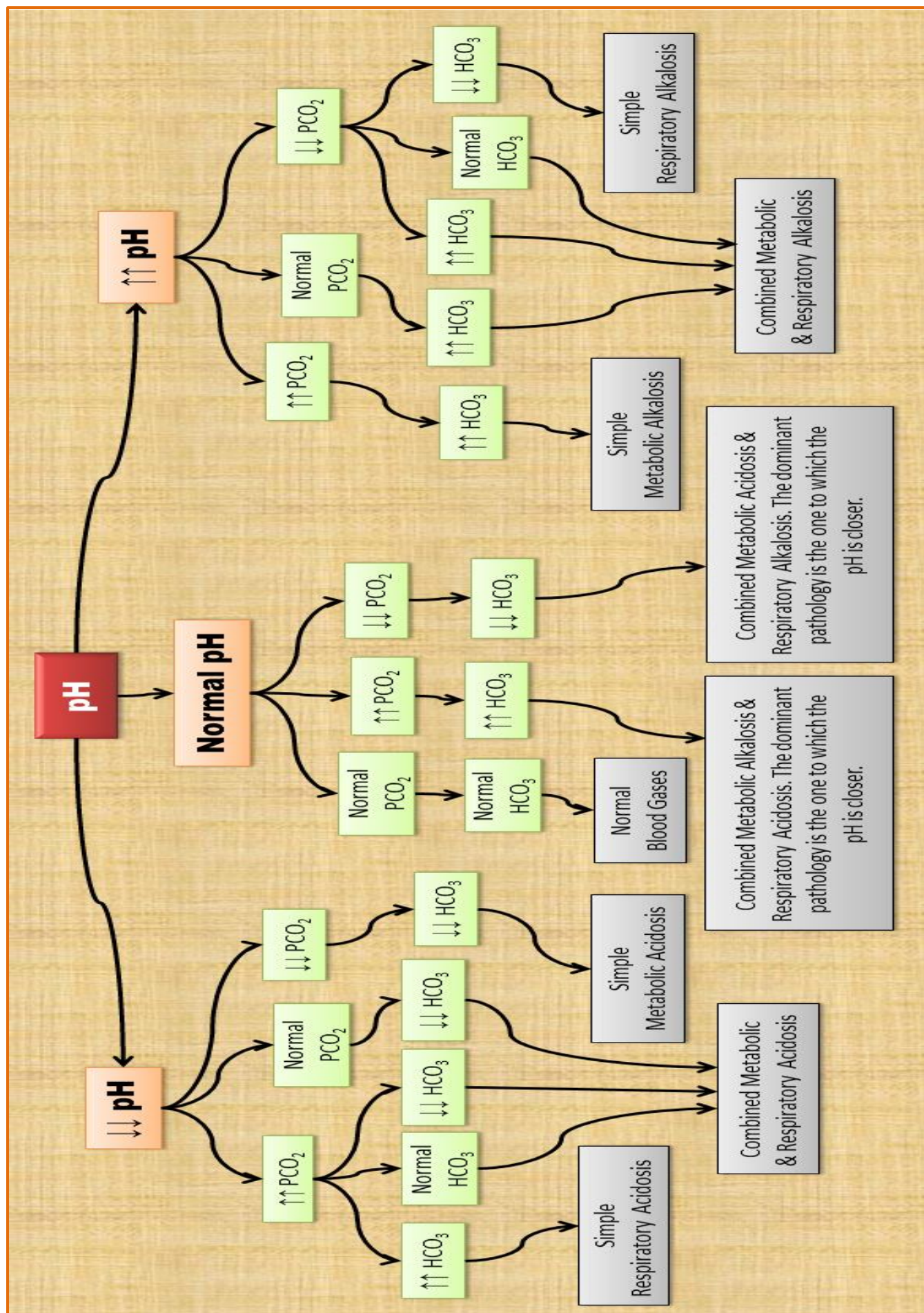
والـ dominant pathology هو اللي الـ pH أقرب ليه ...

يعني لو الـ pH كانت 7.36 يبقى الـ acidotic component هو الـ dominant .

- + High  $\text{PCO}_2$  + High  $\text{HCO}_3^-$  → Combined respiratory acidosis & metabolic alkalosis.

والـ dominant pathology هو اللي الـ pH أقرب ليه ...

 Compensation does not completely correct the change in pH produced by the primary acid-base disorder.



# SHOCK

## Clinical picture

1. Shock on admission.
2. Shock while in ICU.
3. ↑dose of inotropes.

## Differential diagnosis

1. Hypovolemic
2. Cardiogenic
3. Obstructive: pulmonary embolism, pneumothorax & cardiac tamponade.
4. Endocrinal: myxedema & addisonian crisis.
5. Distributive: anaphylactic, neurogenic & septic.

**1. HYPOVOLEMIC SHOCK** → Excluded by static & dynamic measures.

### a) Static measures:

- ♦ CVP → Not accurate but the most available (the gold standard).
- ♦ Others → PAWP, RVEDV & LVEDV.

### b) Dynamic measures:

- ♦ Cardiometry →→ Mini-fluid challenge: 500 ml (150 -200 ml if hypoxic).  
or passive leg raising (مش بيتعمل دلوقتي)  
If > 10% increase in stroke volume → fluid responder ...  
If < 10% → fluid non-responder.
- ♦ Echo → Kissing sign indicates hypovolemia.  
→ IVC collapsibility > 50% in spontaneously breathing patient.  
or IVC distensibility > 15 % in ventilated patient indicates hypovolemia.

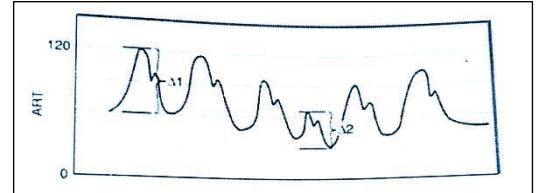
♦ Pulse pressure variation (PPV) =  $\frac{\Delta 1 - \Delta 2}{\left(\frac{\Delta 1 + \Delta 2}{2}\right)} \times 100$

$\Delta 1$  = max. systolic BP - max. diastolic BP

$\Delta 2$  = min. systolic BP - min. diastolic BP

PPV > 13 indicates hypovolemia.

To perform PPV: the patient should be ventilated with TV > 8 ml/kg, relaxed with no arrhythmias.



$$\frac{\Delta 1 - \Delta 2}{\frac{\Delta 1 + \Delta 2}{2}} \times 100\%$$

☞ In case of wet lung (pulmonary congestion → B-lines in lung ultrasound) with poor PF ratio (< 150) → Use vasopressors instead of fluids to maintain BP even in fluid responder patients.

☞ In case of mild hypoxia or cardiac patients → cautious fluid supplementation اديله 100 سم في 100 سم وتابعه



## Bleeding

### ABC (Medical)

- Ensure adequate oxygenation & ventilation. Intubate if necessary.
- 2 wide-bore cannulae + IV fluids ± vasopressors.
- 3 blood samples for Hb, INR & cross-matching:
  - تحجز دم وبلازما وتقف على راس فني المعمل يطلعك المعامل وقتي وانت راجع تستلم الدم والبلازما أو لأ حسب نتيجة المعامل.
- Optimize coagulation state in case of coagulopathy: INR & platelets.
- Hold anti-coagulation & give dicynone, kapron & konakion.
- Stop bleeding if possible till surgical intervention: compression of external bleeding or wash with cold saline in case of hematemesis.

### Abdominal collection

1. Bleeding stump
  2. Bleeding colostomy
  3. Bleeding wound
  4. Hematemesis
  5. Hemoptysis
  6. Intracerebral hemorrhage
- Management: ABC + Surgical.**

- Close follow up of hemoglobin.
- Follow up FAST every 24 hrs or more frequent in case of unexplained instability.
- Erect abdominal x-ray to exclude perforated viscus.

### Visual bleeding

### Closed with packs

- Close follow up of hemoglobin.
- Coagulation profile.
- Intra-abdominal pressure.
- UOP.
- After 2 weeks when packs are removed do ERCP.

## 2. CARDIOGENIC SHOCK

### ECG Topography:

- ♦ Septal → V1, V2
- ♦ Anterior → V3, V4
- ♦ Antero-septal → V1, V, V3, V4
- ♦ Lateral → I, aVL, V5, V6
- ♦ Antero-lateral → V3, V4, V5, V6, I, aVL
- ♦ Inferior → II, III, aVF.

## Cardiogenic shock

### Acute (ECG & Cardiac enzymes)

#### Takatsubo

#### Myocardial infarction (+ve cardiac enzymes)

- ♦ CKMB/CK > 10%.
- لو كانت النسبة ما بينهم أقل من 10 % يبقى احتمال الـ MI ← 2% وميستاهلش تكلف أهل العيان يعملوا troponin بره لأنه عالي مادام العيان شكله مش بالـ History, ECG & Echo.
- ♦ High troponin level → more specific.

### Chronic

- Valvular.
- Congestive HF:
  - ABC
  - Diuretics
  - CPAP mask
  - If BP is adequate → give dobutamine

Diagnosed by assessing COP using VTI (normally >15) because even with poor contractility, COP could be maintained.

## 3. OBSTRUCTIVE SHOCK → All can be diagnosed by echo.

- a) Pulmonary embolism → right side dilatation.
- b) Pneumothorax → right side dilatation & absent sliding in lung ultrasound.
- c) Cardiac tamponade → collapsed ventricles.

#### **4. ENDOCRINAL SHOCK**

- ♦ Diagnosis depends on history & hormonal profile → Myxedema & Addisonian crisis.
- ♦ Myxedema: suspected if female, obese & bradycardic.

Treatment: 300 µg of Eltroxin orally, If ryle → ↑dose by 25 µg.

- ♦ Addisonian crisis: Hepatoadrenal, Pituitary, Adrenelectomy & Patient already on steroids.  
Clinical picture: Metabolic acidosis, Hypovolemia, Hypoglycemia, Hyperkalemia & DCL.  
Treatment: Solucortef IV 100 mg/8 hrs, saline & glucose infusion.

☞ Any hepatic patient on levophed → add solucortef even if on minimal support.

#### **5. DISTRIBUTIVE SHOCK**

##### **a) Anaphylactic shock:**

History of drug intake + skin rash + edema → Management: ABC + Adrenaline 0.5 mg IM.

##### **b) Neurogenic shock:**

- Central (DCL) → Hemorrhage, trauma, tumor.
- Spinal cord (peripheral) → Trauma.

##### **c) Portal vein thrombosis :**

Consider in suddenly collapsing patients with hepatobiliary surgery.

Diagnosis: Shooting liver enzymes + **Doppler**.

If occurring in transplanted patient → Urgent surgical revascularization.

If not → Liver transplantation + liver support → very poor prognosis.

**c) Septic shock:** → diagnosed by exclusion + presence of septic focus.

# MYOCARDIAL INFARCTION

## Clinical picture

Ischemic patient with acute attack of typical chest pain → Angina or MI.

## Diagnosis

**Angina:** Typical chest pain + ECG changes.

### MI:

↑↑ Cardiac enzymes (follow up after 2 hrs then every 8 hrs → If not rising → could be renal or on statins.

+ ECG changes and/or typical chest pain.

In case of +ve ECG changes or typical chest pain with -ve cardiac enzymes → follow up cardiac enzymes after 2 hrs.

## **Differential Diagnosis of Chest pain** → 'Life threatening conditions'

1. MI

2. Pancreatitis

3. Dissecting aortic aneurysm:

- **Diagnosis:**
  - Unequal pulse,
  - Echo: shows ascending & descending aorta
  - CT angiography: the gold standard
  - CXR: wide mediastinum
  - Ultrasound
- **Management in ICU till surgical intervention:**
  - Close monitoring of hemodynamics
  - Control HR & BP because ↑BP & ↑HR → more dissection.
  - Manage as bleeding (see shock).

## Management

### ➤ STEMI:

1. Immediate catheterization
2. Streptokinase.
3. If not available or streptokinase is absolutely contraindicated → Manage as NSTEMI.

### ➤ NSTEMI:

1. **ABC:** Volume (very cautious), BP, Perfusion & Hb (target is 9-10 or hematocrit 27-30).

2. **MONA:**

- ♦ **Morphine:** the drug of choice for analgesia + venodilator → ↓ preload.
- ♦ **Oxygen supplementation:** If  $SO_2 < 90\%$  ... Avoid hyperoxia → ↓ mortality.
- ♦ **Nitrates:** Provided that BP is stable.
  - Nitroderm patch: Not preferred due to its unpredictable absorption + residual absorption after removal.
  - Sublingual tablets: 3 times with 5 minutes interval (1 tab = 2.5 mg).
  - Tridil infusion: Monitor BP.
    - Considered in HF.
    - Once stopped → the effect stops due to the very rapid metabolism of nitroglycerin (1 min).
    - Contraindicated in Hypotension or right ventricle infraction, severe AS, HOCM & PE.



♦ **Anti-platelets:** يتأخذوا وانت واقف

- Aspirin: 300 mg loading then 150 mg/day.

If contraindicated → IV Aggrastat ... In perforated DU → Aspirin protect.

- Plavix: 300 mg loading then 75 mg/day.

or Berlique → Side Effects: Poor compliance (1 tab/ 12 hrs) & dyspnea in 15-30% of patients.

☞ If you shift from Berlique to Plavix → reload Plavix

Stop anti-platelets if platelet count < 50,000

♦ **Anti-coagulant:**

Stable: Clexane: 1 IU/kg/12 hrs (therapeutic dose) according to actual body weight.

Unstable or ↑↑ creatinine: Heparin IV infusion (60 IU/kg IV bolus then 12 IU/kg/hr) →

Target PTT 40 - 70 ... If not available → ½ clexane dose.

If no available syringe pump → IV Heparin 5,000 IU/ 4-6 hrs.

If BMI > 40 → IV Heparin 7,500 IU/ 4-6 hrs.

 Heparin dose in pulmonary embolism: 80 IU/kg IV bolus then 18 IU/kg/hr.

Patients with low platelet count: Arixtra → (therapeutic dose in MI is 2.5 mg/24 hrs

because origin of the clot is arterial), its disadvantage is prolonged half life (needs to stop

36 hrs before regional and 3 days before surgical incision).

**Table 6.5 Weight-Based Heparin Dosing Regimen**


1. Give initial bolus dose of 80 IU/kg and follow with continuous infusion of 18 IU/kg/hr. (Use actual body weight.)
2. Check PTT 6 hrs. after start of infusion, and adjust heparin dose as indicated below.

PTT (sec)	PTT Ratio	Bolus Dose	Continuous Infusion
<35	<1.2	80 IU/kg	Increase by 4 IU/kg/hr
35-45	1.3-1.5	40 IU/kg	Increase by 2 IU/kg/hr
46-70	1.5-2.3	—	—
71-90	2.3-3.0	—	Decrease by 2 IU/kg/hr
>90	>3	—	Stop infusion for 1 hr. then decrease by 3 IU/kg/hr

3. Check PTT 6 hrs. after each dose adjustment. When in the desired range (46-70 sec), monitor daily.

### **3. Statins:**

- Recommended for all patients with MI, irrespective of cholesterol concentration.
- Higher-intensity statin therapy : Atorvastatin (ator) 80 mg/day  
or Rosuvastatin (crestor) 40 mg /day.
- Lower-intensity statin therapy : Simvastatin (zocor) 10 mg/day, used when side effects develop from higher intensity statins in high risk patients.  
Ator → preferred in renal impairment.  
Crestor → preferred in cirrhotic patients with normal enzymes up to 1.5 fold increase & in rhabdomyolysis.  
If liver enzymes ↑ → give half dose.  
If liver enzymes still ↑ → give Zocor.
- Side effects: muscle pain & weakness, could be severe & elevated liver enzymes.

 Any diabetic patient aged > 40 years should be maintained on statin therapy even if not ischemic.

### **4. Rate control:**

- ♦ Concor →→ contractility يعتمد على الضغط وليس  
- Used cautiously in case of poor contractility → قسم الجرعة كل 12 ساعة  
- In hemodynamically stable patient.  
- Target HR: 50-60 bpm or below the trigger in stress ECG.  
- Contraindications: Acute heart failure, Cardiogenic shock, First degree HB & Obstructive pulmonary disease.
- ♦ Procorolan:  
- Dose: 5 - 7.5 mg/ 12 hrs.  
- Given instead of concor in patients with borderline BP.  
- Blocks Na-K channels in SA node (funny channels) .  
- Contraindicated in patients with arrhythmias.
- ♦ Lanoxin:  
- If concor & procorolan are contraindicated.  
- Used with caution in renal patients (adjusted dose & frequent digoxin level).  
- Works in bed-ridden patients, otherwise will not control HR on its own.

### **5. Prevention of remodelling:**

1. **ACEIs (capoten or tritace) or ARBs** → keep an eye on kidney, BP & K.  
In case of creatinine rise more than 50% from **baseline** → stop them .  
Contraindicated in unstable patients.
2. **Aldactone** (If contractility < 30%)  
Side effects of aldactone include: gynecomastia.  
or **Aldosterone receptor antagonists (eplerenone)**: Alternative to Aldactone..  
Recommended in patients with an LVEF ≤ 30%, heart failure or diabetes. It reduces morbidity and mortality in these patients.

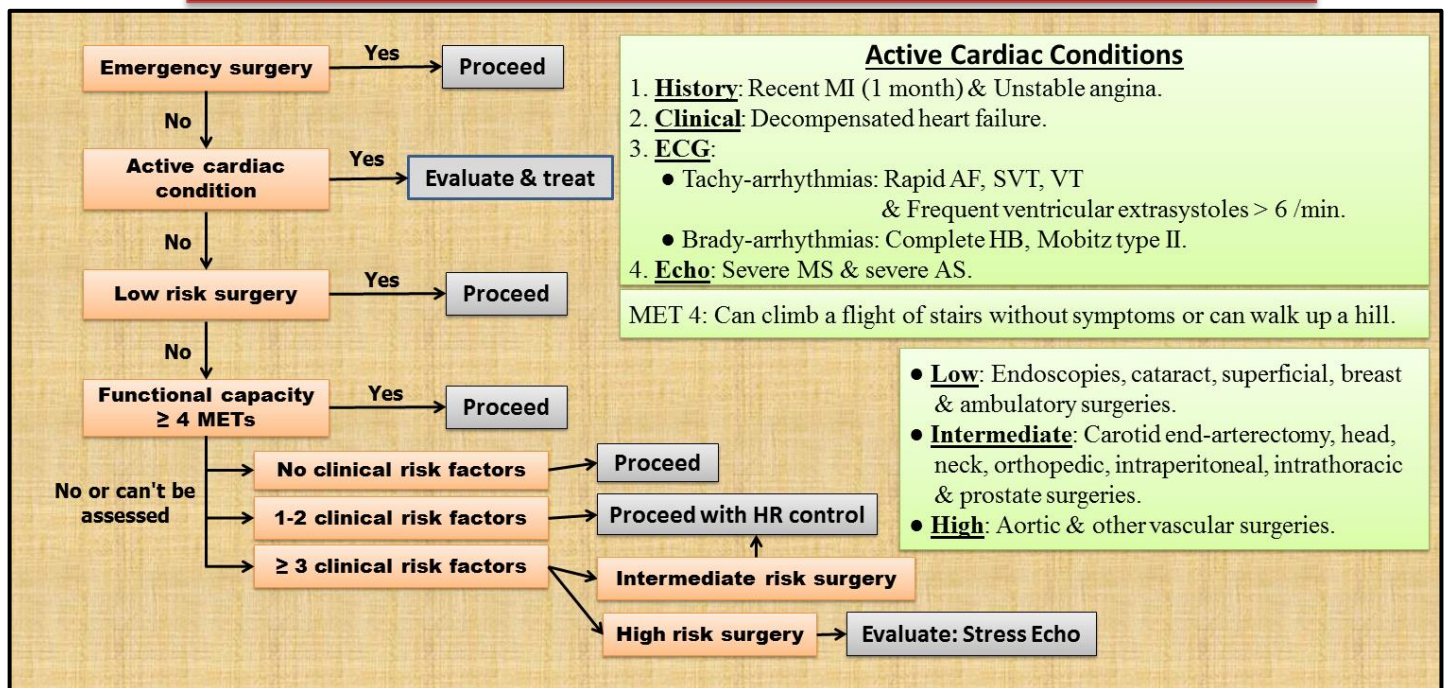
### **6. Angiography & revascularization (PCI or CABG):**

- Immediate within 2 hours: Malignant ventricular arrhythmias, Hemodynamic instability, HF & Severe chest pain despite adequate anti-ischemic & analgesic measures.
- Early angiography (24 hours): High troponin or ST elevation not meeting STEMI criteria.
- Angiography (24- 72 hours): Recurrent angina or EF < 40%, diabetes & renal insufficiency.



- The most important 2 drugs in CPR → Oxygen & Adrenaline.
- During CPR → IV access through femoral (Blind insertion) arterial or venous.
- To perform coronary angiography → The HR should be around 60 ...  
Stop procorolan 48 hrs before angiography.
- Dual anti-platelet therapy for: Balloon angioplasty → 3 weeks  
Metal stent → 6 weeks to 3 months  
Drug eluting stent → 1 year.
- ☞ In this time frame, if a patient requires emergency surgery:  
Hold Plavix → give aspocid + NOACs for 1 week (bridging).  
Stop NOACs 24 hrs before surgery then resume plavix after surgery.  
Provided being in a place with 24 hr catheterization available.
- Stop anticoagulation & anti-platelet therapy if:  
Platelet count < 50,000 or 30,000 in high risk patient ... Or INR 2 - 3.
- In case of thrombocytosis > 1,000,000 → Give aspocid.
- Blood transfusion causes temporary ↑↑ TLC.

### ASSESSMENT OF CARDIAC PATIENT FOR NON-CARDIAC SURGERY



#### Clinical risk factors

Major: Unstable or severe angina, recent MI, decompensated HF, significant arrhythmia, severe MS or AS.  
Intermediate: History of IHD, compensated HF, cerebrovascular disease or renal impairment.  
Minor: Age > 70 years, left ventricular hypertrophy, left BBB, ST-T abnormality & uncontrolled HTN.

- Emergent surgery → Life or limb is threatened if not in operating room within 6 hours.
- Urgent surgery → Life or limb is threatened if not in operating room within 24 hours.
- Time-sensitive surgery → Delay of 1-6 weeks for further evaluation would negatively affect outcome.
- Elective surgery → Delay for up to 1 year.

# ARRHYTHMIA

## Causes of arrhythmias

### 1) Cardiac Diseases

- ♦ Pericarditis, myocarditis, infective endocarditis, RHD, conduction abnormalities & ischemia.

### 2) Non-cardiac diseases

- ♦ Hypo/Hyper-hormones → e.g, hyperthyroidism & myxedema.
- ♦ Sepsis.

### 3) Drugs

- ♦ Anesthetic drugs → e.g, halothane.
- ♦ Non-anesthetic drugs:
  - Parasympathomimetics & Sympathomimetics.
  - Parasympatholytics & Sympatholytics.
  - Anti-arrhythmic drugs → as propafenone.

### 4) Neuro

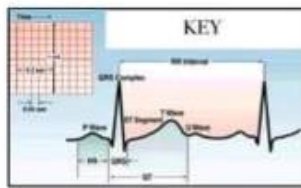
- ♦ Stimulation of areas rich in nerve supply: perineum, ear, nose & carotid body.
- ♦ Central: tumor, trauma & hemorrhage.
- ♦ Peripheral: pain & urinary bladder retention.

### 5) Blood gases abnormalities

- ♦ pH: acidosis or alkalosis
- ♦ Oxygen & CO<sub>2</sub> abnormalities
- ♦ Electrolyte disturbance



# Cardiac Rhythm Analysis Flow Chart



Can upright, smooth and rounded P waves be clearly seen?

YES

NO

IMPORTANT: This flowchart does not factor in the occurrence of atrial or ventricular ectopics. These ectopics may result in an irregular rhythm and should be viewed as an event in addition to the diagnosed rhythm. For example: Sinus Rhythm with Atrial Ectopics

Is every P wave followed by a QRS complex in a 1:1 ratio?

Can narrow or broad QRS complexes be clearly seen?

NO

YES

YES  
3rd Degree Heart Block

NO

Are the QRS complexes > 0.1 seconds in width?

YES

YES  
Ventricular Fibrillation

NO

Asystole

Is the PR interval  $\leq 0.2$  seconds in length?

NO  
1st Degree Heart Block

NO

Are the QRS complexes  $\leq 0.1$  seconds in width?

YES

Is the rhythm regular?

YES  
HR < 60 bpm  
Sinus Brady  
  
HR 60 - 100 bpm  
Sinus Rhythm  
  
HR > 100 bpm  
Sinus Tachycardia  
  
Note: if QRS complexes are > 0.1 seconds in width, there is aberrant conduction present

When there is a PR interval, are they all the same length?

NO  
2nd Degree Heart Block Type 1

YES  
2nd Degree Heart Block Type 2

Are "saw tooth" flutter waves evident?

NO

NO  
Atrial Fibrillation

YES  
Atrial Flutter (Variable Block)

YES

Is the rhythm regular?

YES

Is the rate of the rhythm > 100 bpm?

NO  
Atrial Fibrillation with Aberration

NO  
Idioventricular Rhythm

YES  
Ventricular Tachycardia OR  
SVT with Aberration

NO

Are "saw tooth" flutter waves evident?

YES  
Atrial Flutter (Fixed Block)

Is the rate of the rhythm > 100 bpm?

NO  
HR < 40 bpm  
Junctional Bradycardia  
  
HR 40 - 60 bpm  
Junctional Rhythm  
  
HR 60 - 100 bpm  
Accelerated Junctional

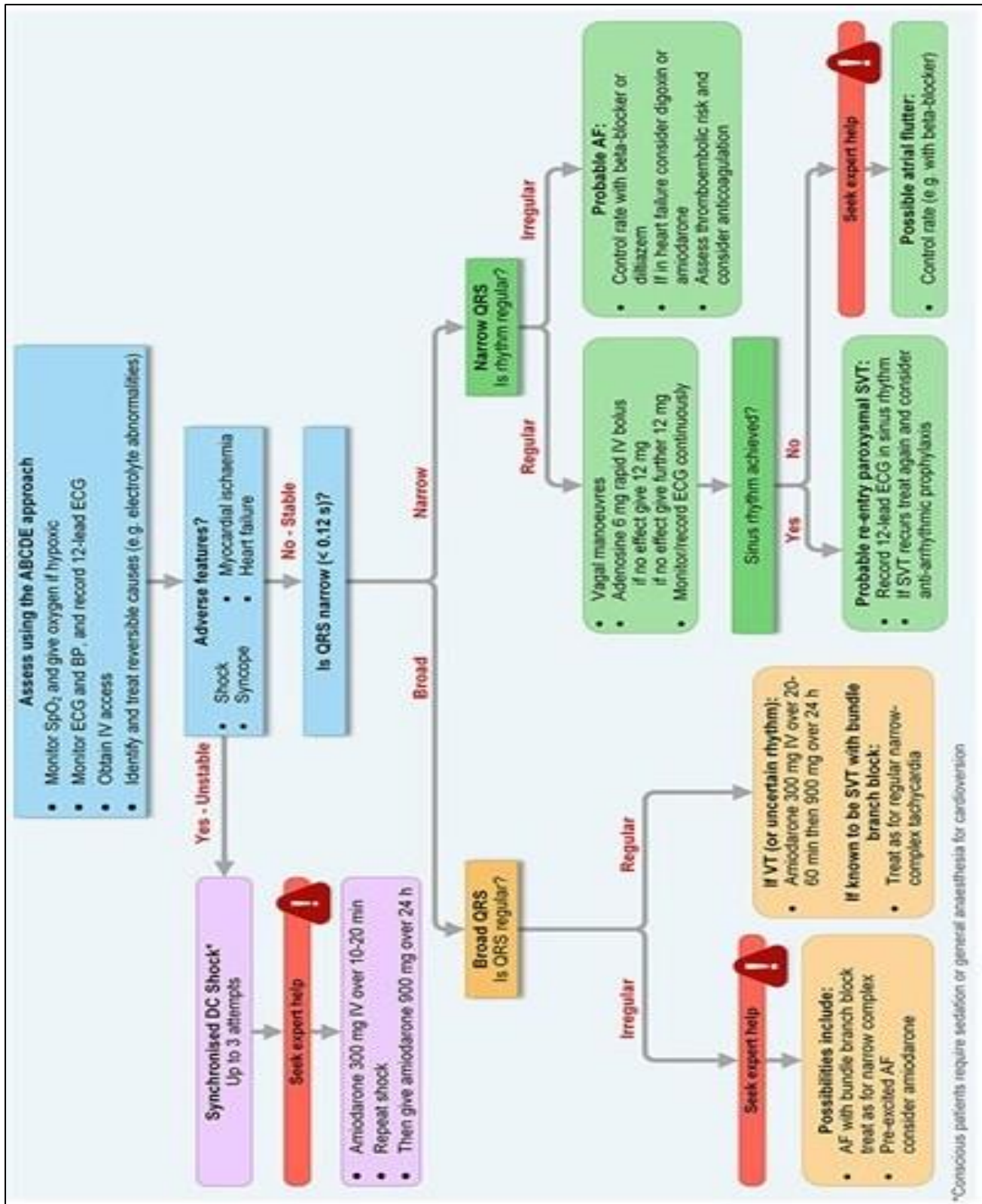
YES  
If P waves are upright, but not well rounded and/or smooth  
Atrial Tachycardia  
  
If P waves are indiscernible or hidden within the QRS complex  
Supraventricular Tachycardia (SVT)  
  
If P waves are upside down  
Junctional Tachycardia

KEY  
Rhythm Originating from the Atria  
Rhythm Originating from the AV Node  
Rhythm Caused by AV Node Dysfunction  
Rhythm Originating from the Ventricles

# TACHY-ARRHYTHMIA

## Initial Management

- ◆ ABC
- ◆ 1. 12-leads ECG    2. ABG    3. Electrolytes    4. IV access    5. Oxygen





- DC of a patient with sinus tachycardia → worsen the condition.
- A patient presented with arrhythmia for the first time → Give 150 mg of cordarone (not 300 mg).
- In case of local anesthetic toxicity presented tachy-arrhythmia → Never give CCB.
- Side effect of adenosine → Bronchospasm.
- CCB should not be given in a patient with EF < 40%.
- Beta blockers are contraindicated in asthmatic patients.
- DC shock should be preceded with sedation & analgesia (dormicum & fentanyl).

## Doses/Details

### **Synchronized cardioversion:**

Initial recommended doses:

- Narrow regular: 50-100 J
- Narrow irregular: 120-200 J biphasic or 200 J monophasic
- Wide regular: 100 J
- Wide irregular: defibrillation dose (*not* synchronized)

### **Adenosine IV dose:**

First dose: 6 mg rapid IV push; follow with NS flush.

Second dose: 12 mg if required.

### ***Antiarrhythmic Infusions for Stable Wide-QRS Tachycardia***

#### **Procainamide IV dose:**

20-50 mg/min until arrhythmia suppressed, hypotension ensues, QRS duration increases >50%, or maximum dose 17 mg/kg given. Maintenance infusion: 1-4 mg/min. Avoid if prolonged QT or CHF.

#### **Amiodarone IV dose:**

First dose: 150 mg over 10 minutes. Repeat as needed if VT recurs. Follow by maintenance infusion of 1 mg/min for first 6 hours.

#### **Sotalol IV dose:**

100 mg (1.5 mg/kg) over 5 minutes. Avoid if prolonged QT.



# ATRIAL FIBRILLATION

## Unstable AF

### Signs of instability:

1. SBP < 90 or MAP < 65 mmHg.
2. Cardiac ischemia or failure: chest pain, ECG changes, ↑ cardiac enzymes or pulmonary edema.
3. Cerebral ischemia: DCL.

**Old > 48 hrs**

**Rapid (> 90 bpm)**

The same as recent.  
Even if showering.

**Slow (< 90 bpm)**

Conservative: maintain rate control by cordarone or lanoxin or both.  
After stabilization → Shift to BB for rate control.

- Any patient reverted to sinus rhythm has to receive anticoagulation according to CHADS-VASc score.
- In resistant AF: consider control of source of sepsis + lanoxin.

في حالات النسا لو الأم دخلت في AF اصبر ع cordarone لحد ما الواد يخرج ويعدين اليه عشال ميجلوش mental retardation & hypothyroidism ... وفي الحالة دي هتدورف الأم مترضعش ابنها لمدة ٤٠ يوم .

**Recent < 48 hrs**

### 1. DC synchronized cardioversion:

If monophasic → 200, 300, 360 joules

If biphasic → 150, 200, 270 joules

- Clear surroundings
- Oxygen supplementation
- Make sure no wires are present under the paddles
- Maintain contact till you see the rhythm

2. Cordarone: 300 mg + correction of reversible causes mainly K & Mg.

3. DC (4<sup>th</sup>): 360 joules if monophasic or 270 joules if biphasic.

4. Cordarone 900 mg over 24 hrs.

5. If reverted to sinus rhythm after DC → Continue cordarone or not ??

☞ If there are no frequent extrasystoles or atrial dilatation → No cordarone.

6. If reverted to sinus rhythm after DC then AF recurred → DC shock again

بالسعة اللي رد بيها + Reload cordarone & then maintenance.



# Stable AF

1. Witnessed (e.g, intra-operative).

2. ECG showing sinus rhythm in the last 48 hrs.  
وفي الحالة دي بنحسب الـ 48 ساعة من لحظة عمل رسم القلب ... ولو قرب يكسر 48 ساعة يتلعب من الأول.

**Recent < 48 hrs**

Target: Restore sinus rhythm

**Old > 48 hrs**

Target: Rate control < 90 bpm  
+ Full anti-coagulation according to CHADS-VASc score.

**Electrical**

- ◆ Obligatory: If chemical failed & about to reach 48 hrs.
- ◆ Elective: من الأول السعة

☞ If reverted to sinus rhythm → continue on medical treatment if there are frequent extrasystoles or atrial dilatation & give therapeutic anticoagulation according to CHADS-VASc score for 1-3 months.

☞ In case of frequent extrasystoles → shift to betacor (sotalol) → BB specific for prevention of AF recurrence.

**Medical**

**As equal**

**1. BB:** The best option in adequate BP.

- If contractility is poor → Give a small & divided the dose.

- BB restores sinus rhythm in 50% of patients with recent AF due to a surgical cause.

**2. Rytmonorm (propafenone):**

- Na channel blocker.
- Class IC anti-arrhythmic drug.
- 4 tablets once.

**3. Cordarone:** In borderline BP or when previous drugs can't be given (NPO patients).  
If failed to restore sinus rhythm after 24 hrs → Reload.

**Drug selection depends on BP & contractility (BCD)**

**1. BB:** the best option in adequate BP.

If contractility is poor → divide the dose.

- Oral: concor.
- IV: Inderal → titrated up to 6-8 mg.

متدشش في السنة أكثر من 3 أميولات

**2. CCB:** in adequate BP **plus** good contractility.

Isopatin (verapamil): 2.5-5 mg IV over 2 min,  
5-10 mg dose maybe repeated after 15-30 min.

or 0.075-0.15 mg/kg (not to exceed 10 mg) IV over 2 min,  
dose may be repeated once after 30 min. from first dose.

**3. Cordarone (amiodarone):** in borderline BP or poor contractility.

**4. Digoxin (Lanoxin):**

In borderline BP, poor contractility or bed ridden patient.

Loading: 1.25 over 30-60 minutes ...

Maintenance: 0.25 mg/day.

ولو الضغط ضبط رجع الـ BB

Score (points)	CHADS-VASc Risk Criteria	CHADS-VASc Score	Recommendation
1	Congestive HF	0	None
1	Hypertension		
2	Age $\geq$ 75 years	1	Aspirin
1	Diabetes		
2	Stroke/TIA/Thromboembolic event		
1	Vascular disease (prior MI/PAD/Aortic plaque)	> 1	Therapeutic anticoagulation
1	Age 65 - 74 years		
1	Sex category: Female sex		



- ☞ In AF resistant to rate control by concor + cordarone + lanoxin → consider uncontrolled source.
- ☞ Recent AF reverted to sinus rhythm with score > 1 → Therapeutic anticoagulation for 1 - 3 months.
- ☞ Old AF on rate control with score > 1 → Maintained on therapeutic anticoagulation for life.
- ☞ **Patients with chronic controlled AF on therapeutic anticoagulation** can be electrically cardioverted to sinus rhythm regarded that there is NO atrial dilatation by trans-thoracic echo **Plus** No atrial thrombus by TEE or Therapeutic anticoagulation for 2-4 weeks before cardioversion.

#### ☞ **Cordarone**

- **Loading dose includes:** 5 mg/kg IV over 1 hr then 15 mg/kg IV over 24 hrs then 200 mg tab/8 hrs for 5-7 days then 200 mg tab/12 hrs for 5-7 days.
- **Maintenance dose:** 200 mg tab/24 hrs.
- **Bioavailability of oral cordarone:** 50% ... If oral intake is contraindicated → 200 mg tab/8hrs can be replaced by 150 mg amp/12 hrs.
- If given together → Cordarone decreases the required lanoxin dose by 25-50%.
- **Adverse effects:** Thyroid dysfunction, IPF, corneal deposits & teratogenicity. Mothers must not lactate their infants after cordarone administration (even a single dose) → hypothyroidism .... Half life: 40-50 days.

#### ☞ **Lanoxin**

- A drug with a narrow therapeutic window, i.e, toxicity occurs easily & close monitoring is mandatory especially in renal patients(bradycardia).
- A weak drug → used in bed ridden patients ... inefficient in active patients.

#### ☞ **Marivan**

- A drug with extensive drug interactions: CCB, Cordarone, Diflucane, Daktarin oral gel, Eltroxin & Fibers-rich food → ↑ marivan effect.
- Diet (greens rich in vitamin K) & Epanutin → ↑ marivan effect.
- Depends on shipping containers.
- Not used in patients with malignancy → give clexane.
- In ICU patients indicated for therapeutic anticoagulation → use clexane or heparin ... Shift to marivan only when preparing for discharge from ICU.

☞ **Procorolan:** Used only in sinus tachycardia ... Contraindicated in presence of arrhythmia.

### **Supraventricular Tachycardia**

- **UNSTABLE** →→ DC shock.
- **STABLE** →→→ Adenosine, BB, CCB, Carotid massage, Cordarone, Digoxin  
According to BP & contractility.



# How to Switch Between Anticoagulants

From	To	How to switch
Heparin	NOAC	Start NOAC at the time of heparin discontinuation
LMWH / fondaparinux	NOAC	Stop LMWH / fondaparinux and start NOAC $\leq 2$ hr before next scheduled LMWH/fondaparinux dose
Warfarin	NOAC	Stop warfarin and start dabigatran/apixaban when INR $< 2.0$ Stop warfarin and start rivaroxaban when INR $< 2.5$
Dabigatran	Warfarin	CrCl $> 50$ ml/min: start warfarin 3 days before stopping dabigatran CrCl 31–50ml/min: start warfarin 2 days before stopping dabigatran CrCl 15–30ml/min: start warfarin 1 day before stopping dabigatran CrCl $< 15$ ml/min: no recommendations provided
Rivaroxaban Apixaban	Warfarin	Start warfarin with rivaroxaban/apixaban until INR $\geq 2.0$ and then stop rivaroxaban/apixaban (INR testing should be done just before rivaroxaban/apixaban dose)
NOAC	Parenteral anticoagulants	Stop NOAC and start parenteral anticoagulant 12 hours after last apixaban/dabigatran dose and 24 hours after last rivaroxaban dose
NOAC	Different NOAC	Administer new agent when next dose is due

## High Thromboembolism Risk Perioperative Bridging

Day	Anticoagulation Plan
Pre-op Day 5	Stop warfarin (last dose on Pre-op Day 6).
Pre-op Day 3	Start therapeutic enoxaparin bridging (1 mg/kg SC q12h) or heparin infusion when INR $<$ goal range.
Pre-op Day 1	Check INR, give vitamin K 1.25–2.5 mg orally if INR $> 1.5$ . Last dose of therapeutic enoxaparin (if using) must be $> 24$ hours prior to surgery.
Day of Surgery	Check INR, consider additional vitamin K if INR $> 1.5$ . Stop heparin infusion (if using) 4–6 hours prior to surgery. Assess hemostasis postoperatively. May resume warfarin evening of surgery if patient taking fluids.
Post-op Day 1	<u>Standard bleeding risk</u> : Resume therapeutic enoxaparin or heparin infusion 24 hours after surgery if hemostasis achieved. <u>High bleeding risk</u> : Consider no bridging or low-dose enoxaparin (40 mg SC daily) 24 hours after surgery if hemostasis achieved.
Post-op Day 2	<u>High bleeding risk</u> : Resume therapeutic enoxaparin or heparin infusion 48–72 hours after surgery if hemostasis achieved.
Post-op Day 4+	Discontinue bridging when INR in goal range.

# POST-ARREST PROTOCOL

## Post-arrest syndrome

- 1) **BRAIN INJURY** →→ Causes late death.
  - ◆ Convulsions → Myoclonus & Tonic clonic
  - ◆ Brain stem death
  - ◆ Coma
  - ◆ Cognitive dysfunction
  - Don't put the patient on muscle relaxant unless EEG is available as it will mask convulsions.
- 2) **MYOCARDIAL DYSFUNCTION** →→ Causes early death.
  - ◆ Hemodynamic instability
  - ◆ Arrhythmia
  - ◆ Myocardial infarction
- 3) **SYSTEMIC ISCHEMIA & REPERFUSION RESPONSE**
  - ◆ Impaired coagulation (DIC).
  - ◆ Vasoplegia due to reperfusion + endothelial damage & ↑ intravascular space.
  - ◆ Impairment of immune system (infection).
  - ◆ Myocardial infarction.
- 4) **PICTURE OF THE PRECIPITATING FACTOR**
  - ◆ Hypovolemia, Hypoxia, Hydrogen ion excess (acidosis), Hypo/Hyperkalemia & Hypothermia.
  - ◆ Tension pneumothorax, Tamponade, Thrombosis (pulmonary or cardiac) & Toxins.

📄 To prevent secondary brain insult you should prevent:

★ Hypo & Hyperglycemia	★ Hyperpyrexia & Rapid rewarming	★ Hypo & Hyperoxia
★ Convulsions	★ Hypotension	

## Management

- 1) **AIRWAY** →→ No need for intubation provided that:
  - ◆ ROSC after 1 cycle
  - ◆ Return of all intellectual functions
  - ◆  $SO_2 > 94\%$  even on oxygen mask
  - ◆ Hemodynamically stable

👉 *Avoid hyperoxia ... Use the minimal  $fiO_2$  that achieves  $SO_2 > 94\%$ .*
- 2) **BREATHING**
  - ◆ Once intubated → insert a ryle.
  - ◆ PEEP: 4-8
  - ◆ TV: 6-8 ml/kg
  - ◆ Avoid hyperventilation & maintain  $PCO_2$  around 40 mmHg to achieve a better neurological outcome.
  - ◆ If sedation was started → don't interrupt before 24 hours.
  - ◆ If tracium is needed for any reason (as ARDS) → EEG is mandatory.
- 3) **CIRCULATION**
  - ◆ Fluid administration according to fluid responsiveness.
  - ◆ Avoid hypotonic solutions.
  - ◆ Avoid glucose containing solutions except in hypoglycemia ... Start ryle feeding early to prevent it. use glucose 25% if you have to.
  - ◆ Inotropic support →→ nor-adrenaline, adrenaline ± dobutamine (if  $ScVO_2 < 65\%$ ).
  - ◆ Serial echo →→ compare contractility.

☼ *The myocardium starts to recover 2-3 days after ROSC.*

☼ *In case of dilated fixed pupil → wait for 24 hours & reassess.*

  - ◆ Hemodynamic goals:
    - MAP > 65 mmHg (> 85 mmHg if hypertensive) with systolic BP > 100 mmHg.
    - UOP > 0.5 ml/kg/hr.
    - Mixed venous saturation: 70%.
    - HR: bradycardic side, If UOP & BP (**Volume – BP – Perfusion**) are maintained with ↓↓ lactate → HR down to 40 is accepted.
    - Keep eye on serum  $K^+$  → transient ↑↑ then it ↓↓ due to intracellular shift by the effect of catecholamines → may lead to arrhythmia up to arrest.

- Correct electrolytes before DC & cordarone.
- Maximum cerebral VC:  $\text{PCO}_2 \leq 20 \text{ mmHg}$  ... Maximum cerebral VD:  $\text{PCO}_2 \geq 80 \text{ mmHg}$ .

#### 4) **DSIABILITY**

##### **a) Cerebral perfusion:**

Maintain MAP between 60-160 ... If cerebral perfusion was affected → multifocal cerebral no flow (takes seconds), global cerebral ischemia (15-30 min) & cerebral hypoperfusion (24 hrs).

##### **b) Sedation:**

- ◆ Once started → don't interrupt before 24 hours.
- ◆ It prevents shivering ... achieved by dormicum, diprivan & desflurane ??

##### **c) Convulsions:**

- ◆ Tonic clonic → Treated by epanutin (phenytoin), tiratam (levetiracetam), intraval, sodium valproate & diprivan.
- ◆ Myoclonus → Epanutin is not effective, treated by tiratam & diprivan.

##### **d) Glycemic control:**

- ◆ Conventional (around 180).
- ◆ Tight (80-110) → High incidence of hypoglycemia → should be avoided
- ◆ Hypothermia → ↑↑ insulin resistance.

##### **e) Hypothermia (Target temperature management):**

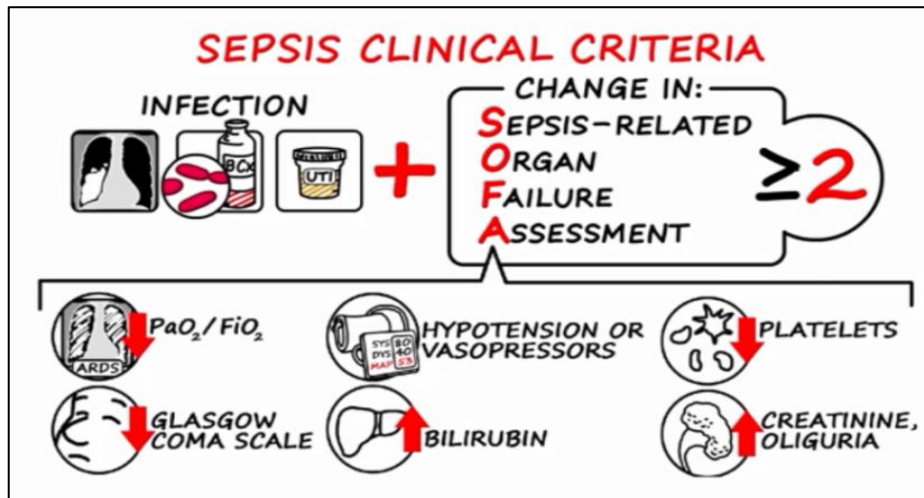
- ◆ Not necessary (evidence c) → Body temperature around  $37^\circ$  is accepted.
- ◆ Mechanism → ↓ CMR.
- ◆ Target:  $33^\circ$ - $36^\circ$ .
- ◆ Rewarming:  $0.25^\circ\text{C}$  -  $0.5^\circ\text{C}$  per hour.
- ◆ Achieved by:
  - 30 ml/kg cold saline.
  - Cold saline in enema, ryle & urinary bladder.
  - Complete removal of clothes.
  - Washing the body with alcohol.
  - Ice or air blanket.
  - $\text{MgSO}_4$  → stops shivering.
  - ECMO or dialysis.
- ◆ Side effects:
  - Shivering: stopped by sedation, muscle relaxation,  $\text{MgSO}_4$  & NMDA antagonists.
  - ↑ SVR & arrhythmias like bradycardia.
  - Diuresis + ↓↓ electrolytes.
  - Hyperglycemia.
  - Infections → Give prophylactic antibiotics as they ↑ survival rate.
  - ↑ Amylase.
  - ↓ Metabolism of drugs ( $34^\circ \rightarrow$  ↓ metabolism by 30%).
  - Impaired coagulation (no study).
- ◆ Contraindications:
  - Pre-existing coagulation disorder.
  - Sepsis.

# SEPSIS & SEPTIC SHOCK

**Sepsis:** A life-threatening organ dysfunction caused by a dysregulated host response to infection.

**Organ dysfunction:** Acute change in total SOFA score  $\geq 2$  points consequent to the infection.

**Septic shock:** Sepsis with persisting hypotension requiring vasopressors to maintain MAP  $\geq 65$  mmHg & having a serum lactate level  $> 2$  mmol/L (18 mg/dL) despite adequate volume resuscitation.



**Quick SOFA:**

- CNS: drowsy
- Chest: tachypnic (RR  $> 22$ )
- CVS: borderline BP (systolic  $< 100$ )

If 2 +ve  $\rightarrow$  ICU admission

## Management of sepsis & septic shock

### ① Supportive treatment (ABC) :

العيان يكون ماسك ضغط و saturation خلال نص ساعة يا إما يوصل max max

♣ Airway protection: Supplemental oxygen  $\pm$  intubation . بمتلكك عشان نحطله أنبوبة

♣ Breathing: Ventilator parameters as ARDS & follow up by ABG.

♣ Circulation: Maintain MAP  $> 65$  mmHg ( $> 80$  if hypertensive) to ensure adequate perfusion.

- امسك الضغط الأول بـ vasopressors وبعدين شوف الـ fluid responsiveness وانزل بالـ vasopressors بعد كده براحتك

Signs of hypoperfusion include:

CNS: DCL.

CVS: Tachycardia, hypotension, weak thready pulse & delayed capillary refill  $> 2$  sec.

Respiratory: Tachypnea.

Renal: Oliguria. Others:  $\uparrow$ Lactate & Cold clammy skin.

### ② Pan-cultures.

### ③ Elimination of Septic focus:

• **Medical:** Broad spectrum antibiotics according to infection site  $\rightarrow$  تتحل وتتأكد وانت واقف بتستلم العيان

In cases with very low TLC count  $\rightarrow$  consider IVIG

If neutrophils  $< 500 \rightarrow$  Neupogen

• **Surgical**

• **Chronic devices:** e.g, CVL.



#### ④ Follow up lactate level (lactate clearance):

After 6 hours → lactate should ↓↓ > 10% ... Target: < 2 mmol/L.

#### ⑤ Fluid resuscitation:

- According to fluid responsiveness (static & dynamic).
- Target CVP: 8 mmHg (12 cmH<sub>2</sub>O) in spontaneously breathing patient and 12 mmHg (15 cmH<sub>2</sub>O) in ventilated patient.
- Crystalloids are preferred.
- Avoid colloids as it may worsen the prognosis.
- Albumin 5% can be used (after 30 ml/kg crystalloids & the patient is still responder).  
بنحط 2 فيال من البيومين 20% (كل فيال 50 سم) على 300 سم رينجر .
- Avoid fluid overload as it may worsen ARDS.
- Stop fluid resuscitation if the patient become stable, non-responder or congested clinically (hypoxic) or radiologically (B-lines in lung ultrasound)... If so & still fluid responder → consider inotropic support.

#### ⑥ Mean ABP:

- Keep MAP > 65 mmHg (> 80 if hypertensive) → Start with levophed then adrenaline.
- If the rate of nor-adrenaline infusion > 6 ml/hr → Add Solucortef 50 mg/6 hrs IV plus Astonine-H (fludrocortisone) 0.1 mg oral tablet/24 hrs.
- Add midodrine or corasore in patients with difficult weaning from levophed, i.e, on minimal dose levophed for long period.
- In bed-ridden patients (especially geriatrics) with difficult weaning from levophed → stop levo, add solucortef + midodrine or corasore & monitor conscious level, UOP & lactate → low BP is accepted in such patients regarding that no deterioration develops in those items.
- In pediatrics: Warm septic shock: start with dopamine → then levo → then adrenaline.  
Cold septic shock: start with dopamine → then adrenaline → then levo.

#### ⑦ Central venous saturation (ScvO<sub>2</sub>):

- Keep it > 65 %.
- If < 65% → improve oxygen carrying capacity by ↑↑ Hb > 9.
- If SPO<sub>2</sub> < 92 % → ScvO<sub>2</sub> has no value in management.
- If still < 65% → start dobutamine infusion in adults (لو ضغطه يسمح) or adrenaline in pediatrics.  
حاليا اتشالت من الحاجات اللي بنتابعها في الـ septic shock لكن ناس كثير مقتنعة إنها مهمة وهترجع تاني.

#### ⑧ UOP: Keep it > 0.5 ml/kg/hr & confirm adequate Peripheral perfusion.

- 📄 Mixed venous saturation (SvO<sub>2</sub>): obtained from pulmonary artery catheter & represents the function of oxygen delivery & extraction in the entire body. Normal value 70-75%.
- 📄 Central venous saturation (ScvO<sub>2</sub>): obtained from CVL (superior vena cava) & indicates oxygen consumption from the upper half of the body including the brain → So, it is slightly less than SvO<sub>2</sub> (about 5). However, in anesthetized patient it increases due to decreased cerebral metabolic rate.

# BURN

## **Burn assessment**

### ① **Percentage.**

② **Degree:** 1<sup>st</sup> → Epithelium      2<sup>nd</sup> → Dermis      3<sup>rd</sup> → Full skin thickness

### ③ **Type & Site:**

- Eye → watch out for corneal ulcers  
→ Ophthalmology consultation
- Airway → Consider intubation (48 hrs ??)  
→ Give anti-edematous measures: Alpha chemotrypsin, Decadrone & Adrenaline neb.
- Lungs → ARDS (consider CO toxicity)

### ④ **Parkland's formula:** 4 ml/kg/% of burn → maximum 50% burn.

- If hypoxic → 3 ml/kg/% of burn.
- If severely hypoxic → 2 ml/kg/% of burn.

### ⑤ **CK, CKMB**

- Follow up for risk of AKI, if CK > 5000 → proper hydration + diuresis + NaHCO<sub>3</sub>

### ⑥ **GIT & feeding:**

- Start oral feeding as soon as possible.
- Adequate caloric intake with external supplement with formulas or IV proteins & glucose.
- Central abdominal pressure in circumferential burns, if more than 20 cmH<sub>2</sub>O :
  1. Ryle
  2. Prokinetics
  3. Release of muscles (if acidotic or oliguric with increased intra-abdominal pressure)

### ⑦ **Pain & Psychosis:** Proper pain control ومتقوّلش إنه بيدلّع

- Opioids
- Gaptin
- Tryptizole
- Seroquel

### ⑧ **Medical:**

- Cultures.
- Antibiotics with sepsis markers.
- IVIG in pediatrics → keep an eye on CNS, CVS & respiratory system.

### ⑨ **Surgical:**

- Early debridement, fasciotomy or any intervention after proper preparation (Hb, platelets, INR).

### ⑩ **Physiotherapy & Out of Bed:** حتى لو هو والتمريض متضايقين اديله مسكن وحركه اللي بيفرق بين عيان بيموت وعيان بيعيش الإرادة والحركة والأكل

## **Indications of ICU admission**

1. Smoke inhalation for fear of airway obstruction.
2. 2<sup>nd</sup> degree burn involving > 25% of body surface area.
3. 3<sup>rd</sup> degree burn involving > 10% of body surface area.
4. Development of complications as sepsis, hypothermia & multi-organ failure.

## **Medical considerations of burn patients**

### **a) Airway considerations:**

#### ➤ Recent burn:

- Face mask → painful & difficult.
- Endotracheal tube → difficult insertion & fixation.

Indications of intubation of burn patient:

Hypoxia, upper airway edema that may progress to obstruction & presence of copious secretions.

Awake fiberoptic may be needed.

Take care of full stomach.

#### ➤ Old burn: Suspect greater difficulty.

### **b) Respiratory considerations:**

#### ➤ Inhalational injury:

- Upper airway edema → obstruction.
- Lower airway direct thermal insult → ARDS.

#### ➤ Carbon mono-oxide inhalation:

- Shift of oxy-hemoglobin dissociation curve to the left.
- Diagnosed by co-oximeter (>15% Carboxy-hemoglobin in the blood).
- Normal PO<sub>2</sub>, skin color and pulse oximeter reading.
- Affinity of CO for Hemoglobin is 210 times that of oxygen.
- Reduces oxygen-carrying capacity.
- CO-Hb level > 20 - 40% are associated with neurological impairment, fatigue, disorientation & shock.
- Half life of CO is 2 - 4 hours.
- Half life is one hour with 100% O<sub>2</sub>.
- Half life is 15 minutes with hyperbaric O<sub>2</sub> (take care of convulsions).

☞ **So:** Secure the airway by intubation, 100% oxygen, humidification of gases & suctioning. Bronchodilators are essential in patients with major burn.

### **c) Cardiovascular considerations:**

#### ➤ Intravascular volume depletion:

- Parkland formula: Lactated Ringer's infusion: 4 ml/kg/ % of involved area in the 1<sup>st</sup> 24 hrs. The 1<sup>st</sup> ½ in the first 8 hours & the 2<sup>nd</sup> ½ in the next 16 hours.
- Fluid therapy should be monitored by urine output (1 ml/kg/hr), blood pressure, static measures (CVP) or dynamic measures (cardiometry).
- Blood, colloids or albumin transfusion may be indicated.
- Inotropic support may be beneficial.
- Early excision + grafting is associated with major blood loss.

### **d) Electrolytes & acid base disturbance:** Follow up & correct.

### **e) Hypothermia:** due to loss of skin.

- Exaggerated by the effects of vasodilatation & large amounts of IV fluids. So, the patient should be warmed.
- Minimized by using warming blankets and heat lamps, Ambient temperature, humidifying the inspired gases and warming the IV fluids.

☞ Normothermia for burn patient is approximately 38.5°C due to resetting of the centrally mediated thermostat.

**f) Immune & septic complications:** Antibiotics & disinfection strategies.

**g) Problems related to artificial nutrition:** See nutrition.

**h) Pharmacology of anesthetic drugs.**

- Sux → allowed in the first 24 hours then contraindicated up to 6 months.
- Non depolarizing muscle relaxants → higher doses are required due to resistance.
- Volatile anesthetics → exacerbate myocardial depression.  
Halothane should be avoided if adrenaline-soaked bandages are used due to higher incidence of arrhythmia.

## **Treatment**

### **1. ABC:**

- Airway & Breathing: Secure the airway by ETT, 100% O<sub>2</sub>, humidification of gases, suctioning & bronchodilators. Daily CXR in case of risk of inhalational injury (ARDS).
- Decadron 1 amp/ 8 hrs for 3 days if airway edema is suspected.
- Nebulized heparin 5000 unit/ 4 hrs for inhalational injury.
- Circulation:  
Fluid resuscitation (Parkland formula).  
Lactated Ringer's infusion: 4 ml/kg/ % of involved area in the 1<sup>st</sup> 24 hrs.  
The 1<sup>st</sup> ½ in the first 8 hours & the 2<sup>nd</sup> ½ in the next 16 hours.  
+ 30 ml/kg/day maintenance.  
Monitored by: UOP > 0.5 ml/kg/hr, MAP > 65 mmHg, static & dynamic measures.

**2. Antibiotics:** See soft tissue infection.

**3. Analgesic antipyretic** → Paracetamol 1 gm/ 8 hrs + morphine 5 mg / 8 hrs.

**4. Anticoagulant** → Clexane 40 mg SC/24 hrs.

**5. Antacid: Losec**

- 40 mg/24hrs for prophylaxis against Curling ulcer (stress ulcer of the duodenum).
- Without antacid prophylaxis → the incidence is high.
- Early enteral feeding plays a great role in prophylaxis.

**6. IVIG:** Indication: Toxic shock syndrome.

Mechanism of action: Neutralization of circulating toxins.

Dose: 100-400 mg/kg ... Vial → 50 ml containing 2500 mg.

Precautions before administration: Hydration with 10 ml/kg saline + anti-histaminic + steroid in case of previous anaphylaxis to IVIG.

**7. Anti-edematous measures:**

- Alpha-chemotrypsin: once or twice daily (IM only) or Alphinert 1-2 tab/8 hrs.
- Decadron 1 amp/ 8 hrs for 3 days.
- Adrenaline nebulizer.

**8. Cevaryl & Becozyme** 1 ampoule IV/24 hrs.

**9. Mebo, Bivatracin & Dermazine** دهان و رش كل 8 ساعات .

**10. Take care of Rhabdomyolysis:** Follow up CK & CKMB.

**11. Insert CVL & Urinary catheter.**

**12. Invasive BP monitoring:** Indicated in the following conditions:

- Difficulty with non-invasive.
- Inotropic support.
- Fluid status assessment using PPV.

**13. Early excision & grafting:** play a great role in improving the outcome.

**14. Gut decontamination ??**

- Amikacin 15 mg/kg/dose (Oral)
- Vancomycin 15 mg/kg/dose or 50 mg/kg/day (Oral)

# ANTIBIOTICS

## Classification of antibacterial agents

Antibiotics that target the cell wall	Antibiotics that block protein production	Antibiotics that target DNA and replication
<ul style="list-style-type: none"> <li>➤ <math>\beta</math>-Lactam Antibiotics</li> <li>➤ Glycopeptides</li> <li>➤ Colistin</li> </ul>	<ul style="list-style-type: none"> <li>➤ Macrolides</li> <li>➤ Aminoglycosides</li> <li>➤ Clindamycin</li> <li>➤ Tigecycline (Tygacil)</li> <li>➤ Linezolid (Zyvox)</li> </ul>	<ul style="list-style-type: none"> <li>➤ Quinolones</li> <li>➤ Metronidazole</li> <li>➤ Sulphonamides.</li> </ul>

## Antibiotics that target the cell wall

### ➤ **$\beta$ -Lactam Antibiotics:** Bactericidals

#### ★ Penicillins:

- ◆ Naturally occurring penicillins. Active against gram +ve e.g. penicillin G.
- ◆ Anti-staphylococcal penicillins with extended spectrum against gram +ve e.g. Methicillin.
- ◆ Amino-penicillin with activity against gram -ve e.g. Ampicillin
- ◆ Extended spectrum penicillins: Active against gram -ve & pseudomonas e.g. Piperacillin.
  - ✎ Penicillins with  $\beta$ -Lactamase inhibitors:
    - Ampicillin-sulbactam → Unasyn / Unictam
    - Amoxicillin-clavulanate → Augmentin
    - Piperacillin-tazobactam → Tazocin

#### ★ Cephalosporins

- ◆ First generation → Effective against gram +ve e.g. Cephazolin.
- ◆ Second generation → Extended activity against some gram -ve e.g. Cefotetan.
- ◆ Third generation → More effective against gram -ve e.g. Ceftazidime (Fortum).
- ◆ Fourth generation → Has good gram +ve and gram -ve e.g. Cefipime (Maxipime).
- ◆ Fifth generation → Has expanded the activity against gram +ve to include MRSA e.g. Ceftaroline

#### ★ Carbapenems

- ◆ Imipenem-cilastatin (Tienam) → active against gram +ve, gram -ve and anaerobic bacteria
- ◆ Meropenem (Meronem).
- ◆ Doripenem.
- ◆ Ertapenem (Invanz) → Does not cover pseudomonas → Not used in chest infection.

#### ★ Monobactam: Aztreonam, gram -ve only, not used.

### ➤ **Glycopeptides:**

- Spectrum: Gram +ve & staph.
- ◆ Vancomycin:
  - The most effective anti-staph.
  - Nephrotoxic + Red man syndrome if > 50 mg/min (histamine release → VD → redness of upper half of the body → TTT: hydration + anti-inflammatory).
  - Avoided by infusion over 1 hour.
- ◆ Teicoplanin (Targocid)
  - less nephrotoxic
  - Dose: Loading 400 mg/12 hrs for 3 doses then 400 mg/day.

➤ **Colistin**

- Belongs to polymyxin group of antibiotics.
- Spectrum: Gram – ve only.
- Better to be used with another agent: sulperazone/unasyn or zyvox/vanco/targocid.
- Can be given by inhalation in cystic fibrosis or lung abscess.
- Severely Nephrotoxic → adjusted in renal impairment.
- Dose: Adults: Loading: 9 million units → Maintenance: 4.5 million units/12 hrs.  
Pediatrics: 2.5 - 5 mg/kg/day divided into 3 doses (No loading dose).

كل مجم فيه 34 وحدة ... اضرب الجرعة في 34 عشان تطلعها بالـ units .

**Antibiotics that block protein production**

➤ **Macrolides:**

- Erythromycin, Clarithromycin, Azithromycin
- Spectrum: Gram +ve & atypical bacteria → Used in community acquired pneumonia.

➤ **Aminoglycosides**

- Spectrum: Gram -ve & staph.
- Nephrotoxic & ototoxic.
- Can be given by inhalation.

➤ **Clindamycin (Dalacin)**

- Spectrum: Gram +ve & anaerobes → Used in soft tissue infections.
- 👉 Adverse effects: Psuedo-membranous colitis → treated by flagyl.

➤ **Linezolid (Zyvox):**

- Spectrum: Gram +ve & staph.
- High bioavailability (easy to switch to oral therapy).
- Used safely without adjustment in renal failure.
- Photosensitive (special cover) + large volume (600 ml/day).
- Adverse effects: Lactic acidosis, thrombocytopenia (after 10-14 days).

➤ **Tigecycline (Tygacil)**

- Spectrum: Gram +ve, staph, anaerobes & gram -ve but not pseudomonas & proteus.
- Used in soft tissue & abdominal infections being concentrated in soft tissues & abdomen.
- Does not maintain adequate blood level → Not used alone in septicemia.
- Not good in chest infection (pseudomonas + poor chest penetration).
- Used safely without adjustment in renal failure.
- Dose: Loading 100 mg once then 50 mg/12 hrs ..  
In chest infection & septicemia 200 once → 100/ 12 hrs.

**Antibiotics that target DNA and replication**

➤ **Quinolones**

- Ciprofloxacin (Cipro) & Levofloxacin (Tavanic).
- Spectrum: Gram -ve, atypical & some gram +ve.
- Adverse effects:

Pediatrics: Immature closure of epiphysis, so contraindicated in children below 18 years but can be used for 1 week.

Geriatrics: DCL.

Prolonged QT interval & predispose to ventricular arrhythmias.

➤ **Metronidazole (Flagyl)**

➤ **Sulfonamides**



	Gram-positive Bacteria	Gram-negative Bacteria	Anaerobes	Atypical Bacteria
Amino-penicillin	←→			
Piperacillin	←→	←→		
3 <sup>rd</sup> generation cephalosporins	←→	←→		
Carbapenems	←→	←→		
Glycopeptides	←→			
Tygecyline	←→			←→
Macrolides	←→			←→
Quinolones	←→	←→		←→
Aminoglycosides	←→	←→		
Clindamycin	←→		←→	

### Infections in ICU:

1. **Pneumonia:** Hospital-acquired & community-acquired.
2. **Peritonitis:** Primary & secondary.
3. **Soft tissue infections:** as Necrotizing fasciitis & forneir gangrene.
4. **Diabetic foot.**
5. **Infective endocarditis.**
6. **FB in the eye.**

## **1. Chest infection**

### ➤ Diagnosis of pneumonia

1. Radiological finding.
- ± 2. Fever / productive cough / hypoxia / aspiration / culture.

### **1. Hospital acquired pneumonia and ventilator-acquired pneumonia**

- Organism: Usually gram negative.
- Use dual anti-pseudomonal drugs:

Maxipime → لو العيان ماسك نفسه

Tazocin/Tienam/Meronem → لو العيان متكحول

(Tienam & Meronem are slightly superior to Tazocin)

+ Aminoglycoside (Amikan or Gentamycin) / Quinolone (Cipro or Tavanic)

- If the incidence of MRSA > 10% → add anti-staph: Vanco / Targocid / Zyvox.

### **2. Community-acquired pneumonia**

- Organism: Strept. pneumonia, H. influenza & Atypical organisms.
- No risk of pseudomonas: Tavanic / Augmentin / Rocefin / Maxipime  
± Klacid / Zithromax severe cases.
- Risk of pseudomonas or hemodynamically unstable: as hospital acquired pneumonia (without anti-staph).

piperacillin-tazobactam 4.5 g IV/6hr OR
Imipenem 500 mg IV q 6h OR
Meropenem 1 g IV q 8r OR
<b>plus</b>
Vancomycin 15 mg/kg IV q12h or linezolid 600 mg IV/PO q12h
<b>plus</b>
Aminoglycoside (gentamycin 7 mg/kg/day IV or Amikacin 15 mg/kg/day IV) OR
Ciprofloxacin 400 mg IV q8h

#### **Risk of pseudomonas**

- Alcoholism
- Chronic bronchiasis
- Mechanical ventilation
- Febrile neutropenia
- Septic shock with organ failure

N.B, In chest infections, focus on anti-pseudomonal & don't rush to anti-gram +ve.

## 2. Abdominal infection

**Primary peritonitis:** عيان بطنه اتفتحت مرة واحدة

لو عيان كويس وماسك نفسه ← 3<sup>rd</sup> or 4<sup>th</sup> generation Cephalosporin + Flagyl

لو عيان متكحول ملوش غير فرصة واحدة بمعني :

Hemodynamically unstable, prolonged hospital stay, immunosuppressed, on steroids

في الحالات دي بنبدأ من الأول بواحد من العائلات الكبيرة من الـ antibiotics اللي هي Tienam, Meronem, Invanz, Tazocin

**Secondary Peritonitis:** عيان بطنه اتفتحت أكثر من مرة →  $\pm$  antifungal  $\pm$  antistaph.

☞ **Indicators of improvement or deterioration:**

1. Fever
2. Lactate
3. TLC
4. CRP
5. Dose of vasopressor

☞ **لو العيان لسه مطلعلوش مزارع ومش بيتحسن ننزل بسهمين Medical & Surgical**

### Surgical → كلم الكبير يكلم الكبير

**Check Chronic devices & Surgical source of sepsis:**

- ♦ Chest: Abscess, empyema, pneumonia with complete obstruction (for bronchoscopy).
- ♦ Abdomen: leakage (collection) & surgical wound.
- ♦ Soft tissue: diabetic foot for debridement or amputation, pockets of pus, vacuum.

### Medical

◀ لما تيجي تنقل من كل step للي بعدها لازم تراجع سهم الـ surgical source + devices وتتأكد إنه controlled الأول ...

لو مش controlled بنتخانق مع الجراح وننقل للخطوة اللي بعدها (extend the spectrum).

◀ لو العيان بيوقع بسرعة خش برجالتك كلهم لكشة واحدة لأنه مش هيستحمل 48 ساعة.

◀ لو انت بادئ بالجروب الاول انقل علي جروب التينام أو اخواته.

◀ لو انت بادئ بجروب التينام هتزداد الآتي:

**Add extreme anti-gram positive (MRSA) especially in case of burn, soft tissue or abdominal infection** as Vancomycin, Targocid or Zyvox.

◀ لو مفيش تحسن بعد 48 ساعة:

**Add antifungal:** Diflucan (in stable patients or can't afford)

or V-fend (voriconazole) if unstable patients or if diflucan is endemic.

or Amphotericin B: The gold standard of anti-fungal drugs:

Conventional form → Fungizone (nephrotoxic, hepatotoxic, ↓K) → cheap 125 LE.

& Liposomal form → Ampisome (no adverse effects) → expensive 1820 LE !!

or Echinocandins → Mycamine (Micafungin), Ecalta (Anidulafungin), Cancidas (Caspofungin) → very expensive.

◀ لو مفيش تحسن بعد 48 ساعة زود Extreme anti-gram negative

#### Hopeful

● **Can afford:**

A) Add extreme gram -ve (MDR Acinetobacter, E.coli, Pseudomonas, Proteus) as Colistin.

B) In soft tissue or abdominal infections → add Tygacil.

● **Can't afford:**

Available donations → Colistin.

No available donations → Tygacil.

In chest infection: consider Amikan nebulizer 400 mg/12 hrs.

#### Hopeless

● **Can't afford:**

يكمل على اللي ماشي عليه وخلص  
بس لو فابق اديله Tygacil ... واسمح بدخول أهله  
لو وسخ وبيسب الدين ← لقنه الشهادة ونيمه  
ومتصحيهوش ثاني.

● **Can afford:**

لو عابزينه معاهم يشتروا Colistin.

لو عابزينه يترحم يكمل على اللي ماشي عليه.

◀ لو متحسنش بعد 48 ساعة ← **Consider viral** (in pneumonia cases), **TB**, or **infective endocarditis**

## لو العيان طلعله مزرعة

1. لو العيان بيتحسن والمزرعة طلعت resistant للمضاد الحيوي اللي ماشي عليه و sensitive لمضاد حيوي ثاني يبقى ننفذ للمزرعة .
2. لو العيان مش بيتحسن والمزرعة طلعت مضادات حيوية غير اللي أنا كاتبها يبقى تمشي مع المزرعة وبرده تتأكد من السهم ال surgical .
3. لو العيان بيتحسن علي المضادات اللي أنا كاتبها والمزرعة طلعت sensitive لواحد منهم تحديداً يبقى نكمل علي اللي طلع في المزرعة و نوقف الباقي (de-escalation) .
4. لو العيان مش بيتحسن والمزرعة طلعت sensitive لنفس المضادات اللي ماشي عليها يبقى نفضلها ونرجع لل algorithm .

☞ **MALDI TOF:** مزرعة بتطلع نتيجتها خلال 24 ساعة ... موجودة في مستشفى 57357

### 3. Soft tissue infection

- Stable: 3<sup>rd</sup> or 4<sup>th</sup> generation + Anti-staph + Dalacin
- Unstable: Invanz/ Tienam/ Meronem/ Tazocin + Anti-staph + Dalacin.

### 4. Diabetic Foot

- **Stable:** 3<sup>rd</sup> or 4<sup>th</sup> generation cephalosporin + Dalacin
- **Unstable:** start with Invanz/ Tienam/ Meronem/ Tazocin + Dalacin.

### 5. Infective Endocarditis

Gentamycin + vancomycin + 3rd generation cephalosporin or Invanz/ Tienam/ Meronem/ Tazocin  
Give full anti-coagulation if there is no risk of bleeding or candidate for surgery → قلب وقلب وصدر

### 6. Intraocular → Vancomycin.

### 7. Compound depressed skull fracture → Vancomycin + 3<sup>rd</sup> generation cephalosporin.



- ☞ Immunocompromised patients on maximum inotropic support due to septic shock can be given 10 gm of IVIG.
- ☞ Anti-staph antibiotics: Vancomycin, Targocid, Zyvox
- ☞ Antibiotics act by either:
  - ◆ Peak serum level: given once daily as aminoglycosides.
  - ◆ Steady serum level: multiple doses.
- ☞ Extreme gram +ve: MRSA
- ☞ Extreme gram -ve: MDR → Pseudomonas, Klebsiella, Acinetobacter, E.coli



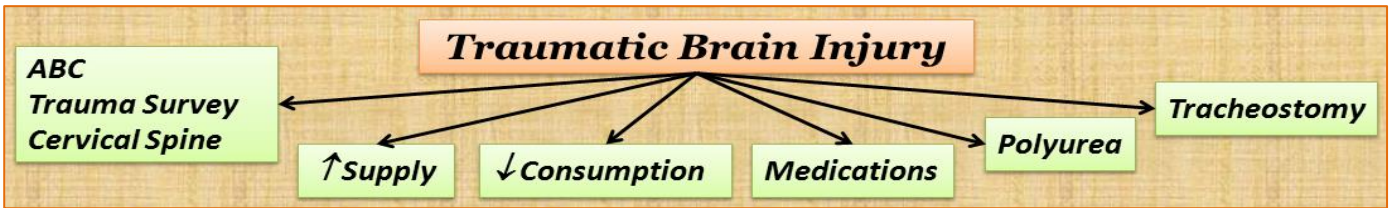
## ANTIBIOTIC SUSCEPTIBILITIES IN INTENSIVE CARE

GRAM POSITIVE				GRAM NEGATIVE										
Cocci				Anaerobes		Cocci/Coccobacilli			Bacilli					
MRSA <i>S. epidermidis</i> (coagulase +ve Staphylococcus)	MRSA	Enterococcus Faecium Faecalis	Streptococcus	<i>Clostridium</i> <sup>1</sup> <i>Peptostreptococcus</i>	<i>Bacteroides</i> , <i>Fusobacterium</i>	<i>Neisseria meningitidis</i>	<i>Haemophilus influenzae</i>	<i>Moraxella</i>	<i>E. coli</i>	<i>Klebsiella</i>	<i>Proteus mirabilis</i>	<i>Pseudomonas</i>	ESCAP <sup>2</sup> organisms	<i>Legionella</i>
Amoxicillin <sup>3</sup>				Amoxicillin-clavulanate				Azithromycin, Erythromycin						
Flucloxacillin		Clindamycin		Clindamycin <sup>3</sup>										
Rifampicin/Fusidic Acid		Fusidic Acid		Metronidazole <sup>4</sup>		Rifampicin/ Fusidic Acid		Rifampicin						
Vancomycin/Teicoplanin <sup>5</sup> , Linezolid, Daptomycin				Vancomycin/ Teicoplanin										
Co-trimoxazole				Co-trimoxazole										
Gentamicin <sup>6</sup>		Gentamicin/ Tobramycin		Trimethoprim				Gentamicin/Tobramycin						
Moxifloxacin		Cephazolin		Cefuroxime, Ceftriaxone		Moxifloxacin <sup>3</sup>		Cephazolin		Cefuroxime <sup>7</sup> , Ceftriaxone		Ceftazidime <sup>8</sup>		
Cefepime		Piperacillin-tazobactam		Cefepime		Ciprofloxacin, Aztreonam		Moxifloxacin						
Meropenem, Imipenem		Ertapenem		Tigecycline										
Tigecycline														



# TRAUMATIC BRAIN INJURY

- ⊛ **Any Trauma:**
- ABC
  - Trauma Survey
  - Management of emergency (e.g. rupture spleen)



## Care of cervical spine

- ✋ Any fracture spine → Neurological assessment & stability of fracture ± Solumedrol.
1. The patient should be on a hard surface wearing a neck collar.
  2. Cervical spine should be at the same level with the head & shoulders.  
إزاي تنقل العيان؟ هدفك إن ال shoulders, head & neck يتنقلوا one unit فيما إما على hard board أو إيديك الاثنين تحت اكتافه زي الجاروف وراسه مسنودة بال forearms عشان تضمن إن راسه في نفس مستوى اكتافه فترفعه one unit .
  3. IV Solumedrol → 30 mg/kg over 1 hour,  
then 5 mg/kg/hr for 24 hours if started within 8 hours from the time of trauma.  
or 5 mg/kg/hr for 48 hours if started after 8 hours from the time of trauma.  
In case of complete avulsion of the cord → No role for solumedrol.

## Differential diagnosis of DCL

### a) Intra-cranial:

- ★ **Trauma:** Hemorrhage, contusion, compound depressed fracture & diffuse axonal injury.
- ★ **Infections:** Brain abscess, meningitis, encephalitis.
- ★ **Tumor:** Brain tumor.
- ★ **Others:** Stroke, Hypertensive encephalopathy & Epilepsy.

### b) Extra-cranial:

- ★ **Drugs:** Addiction & Iatrogenic (e.g, dormicum).
- ★ **Blood gases abnormalities:** Severe acidosis or alkalosis, hypercapnea, hypoxia, hypoglycemia, electrolyte disturbance.
- ★ **System failure:** Hepatic encephalopathy, Uremic encephalopathy, Addisonian crisis & Myxedema coma.
- ★ **Severe sepsis.**

- ♦ **Primary brain injury:** Occurs at the time of trauma & can't be treated الحنة اللي اتخبطت وماتت خلاص .
- ♦ **Secondary brain injury:** Ischemic brain injury that occurs after the initial trauma had occurred.  
المنطقة اللي حولين الحنة اللي ماتت (ممکن تموت نتيجة ال ischemia & inflammation لو حصل hypoperfusion or hypoxia ... هدفك إنك تمنع ال 2ry injury)

**Goal** (to avoid 2<sup>nd</sup> brain insult from ischemic penumbra)

**1. ↑ Oxygen supply to the brain = ↑ CPP**  
**CPP = (MAP - ICP)**

**Content + ضغط**

**1. MAP:** Keep it > 65 mmHg ... > 90 mmHg in hypertensive patients.

N.B. Cerebral autoregulation: MAP 50-150.

**2. Hemoglobin:** > 9 gm/dl.

**3. Avoid hypoxemia:** Keep SO<sub>2</sub> > 90%.

**4. Reduction of ICT:** see below.

**2. ↓ Oxygen consumption by the brain**

**1. Anti-epileptics:**

♦ Convulsions increases cerebral O<sub>2</sub> consumption by 300%.

♦ If no convulsions occurred → Give anti-epileptic for 1 week only.

♦ If convulsions occurred → Continue anti-epileptic for 6 - 12 months.

♦ Infra-tentorial injuries or deep white matter injuries are not indications for anti-epileptics. بعيدة عن الموتور

♦ Any attacks of rigidity, tachycardia or hypoglycemia → consider sub-convulsive fits → Do EEG, CT or MRI with diffusion + Epanutin level.

♦ Status epilepticus → Give maximum doses of dual anti-epileptic drugs + diprivan or dormicum infusion for 48 hrs then do EEG → if controlled → stop infusion.

If EEG is not available → decrease dose of infusion gradually 20% by 20%.

NEVER to give a muscle relaxant to stop convulsions → كده البوردة هتتحرق في صمت

**2. Avoid fever:** because rise of temperature by 1°C → ↑CMR by 7%.

**3. Hypothermia:** controversial.

**3. Medications**

■ **PK Merz:** Used cautiously in case of recent convulsions or agitation as it may worsen them.

Dose: 5 mg/kg. Adjusted in renal patients.

■ **Melatonin:** Facilitates restoration of physiological rhythm والنوم والصحيان & improves the conscious level.

Dose: 3-10 mg/kg/day. Can be increased up to 20 mg/kg/day in brain edema.

لكن عندنا بندي 3-10 mg/day

☞ **Epanutin** interacts with procorolan & nimotop.

☞ **Tiratam (Levetiracetam)** is available in IV form 500 mg, tablet & syrup forms.

☞ **Tiratam** tablets should not be crushed → If cannot be swallowed → Give the syrup form.

☞ All **steroids** are contraindicated in TBI. It may worsen the prognosis.

☞ **Maxipime & Tienam** → ↑ risk of convulsions especially in renal patients.

**Signs of brain edema in CT (بالترتيب ده)**

- Occluded basal cisterni.
- Obliterated sulci & gyri.
- Compressed ventricles

**Status Epilepticus**

● Dual anticonvulsant drugs (maximum doses) + dormicum, diprivan or kataral infusion for 48 hrs.

لو ضغطه يسمح بيقى diprivan ... لو ميسمحش بيقى dormicum

لو عيان ضغطه ميسمحش وعنده renal impairment بيقى kataral

لو kataral مش موجود ممكن تنيمه بـ diprivan وتسندده بليفو .

☞ **Emergency hypertension:** Dual maximum dose anti-hypertensive drugs + tridil infusion.

● If EEG is free for 48 hrs → stop infusion.

● If EEG is not available → ↓ dose of infusion gradually 20% by 20%.

● NEVER to give a muscle relaxant to a patient with convulsions → كده البوردة بتتحرق في صمت



## Lens Adams Syndrome

Post-arrest convulsions.

Treatment: same as status epilepticus + Nootropil up to 9 gm plays a major role.

## Intra-cranial pressure

■ ICP is formed by the brain (80%), CSF (8%) & Blood (12%).

■ ICP: 12-15 mmHg. ■ IOP: 15-20 mmHg.

■ ↑ ICP: 1. CSF displacement

2. ↓CSF production

3. Brain herniation

4. Finally conization → Cushing triad → hypertension, bradycardia & circadian rhythm

يعني بتيجي في صورة attacks بتاخد لها ربع ساعة وبتفك عشان بيحصل drainage لشوية CSF فالضغط على الـ centers يقل فيفك وبعدين الـ tension يعلى تاني فيضغط على الـ centers تاني فيدخل في hypertension & bradycardia تاني وهكذا .

## Methods to reduce ICP

### 1. Airway:

- Adequate pre-oxygenation & analgesia → fentanyl.
- Adequate muscle relaxation → sux or tracium, consider pre-curarization by 10 mg tracium.  
Give a muscle relaxant even if GCS < 8 to prevent cough reflex → to avoid ↑↑ ICT.  
Give a muscle relaxant during transfer of intubated patients with TBI to prevent cough reflex ...
- Adequate hypnosis without affection of BP (only 50 mg diprivan).
- Xylocaine → gel on tube, spray on vocal cords & IV... Use β-blocker & Magnesium.
- Avoid tridil as it ↑↑ ICT ... Trimetaphan can be used to ↓↓ BP without ↑↑ of ICT.
- Avoid sympathomimetics, para-sympatholytics, kataral, hypoxia & hepercapnea.

### 2. Positioning:

- a) 30° - 45° Head elevation with central head positioning to allow drainage of IJV.
- b) 3 fingers between angle of mandible & clavicle, 3 fingers between chin & suprasternal notch).  
ليه 30° ؟؟ لأن ده أحسن وضع يحصل فيه venous drainage كويس من غير ما الـ blood supply يقل .
- c) طوق سواقة

### 3. Controlled Ventilation:

- Target  $PO_2 > 60$  mmHg,  $SO_2 \geq 90\%$ ,
- $PCO_2$ : 30-35 mmHg.
- To achieve hypocapnea → ↑TV is more effective than ↑RR as alveolar ventilation = (TV - dead space) x RR.  
e.g:  $MV = 600 \times 10 = 6$  liters.  
 $AV = (600-200) \times 10 = 4$  liters  
 $AV = (600-200) \times 12 = 4.8$  liters  
 $AV = (700-200) \times 10 = 5$  liters
- All inhalational anesthetics ↑ ICT by cerebral vasodilatation: Halothane by 200% → ↓by hyperventilation before introducing it ... Isoflurane by 50% → ↓by concomitant hyperventilation.

#### 4. **Drugs:**

##### ➤ Mannitol:

- ◆ Dose: 0.25 - 1 gm/kg ... Onset: 15 min, maximum effect: 45 min, duration: 6 hrs.  
No benefit from increasing the dose > 1 gm/kg → ↑ duration of action without ↑ effect .
- ◆ Mechanism of action: Osmotic diuretic, anti-oxidant (scavenger for oxygen free radicals) & initial hemodilution → ↓↓ blood viscosity & ↓↓ CSF synthesis.
- ◆ Contraindications: Cardiac, renal (oliguria or anuria) & intracranial hemorrhage.

- Lasix: loop diuretic + ↓↓ CSF synthesis + synergistic effect with mannitol.
- Precedex (Dexmedetomidine) & Aminophylline.
- Magnesium.
- Xylocaine infusion: 1-4 mg/minute.
- TIVA (propofol): بشرط الضغط يستحمل → 10 mg/kg in 1<sup>st</sup> 10 min, → 8 mg/kg in 2<sup>nd</sup> 10 min, → 6 mg/kg after that.

#### 5. **Electrolytes:** Correct electrolytes especially after mannitol intake.

#### 6. **Fluids:**

- ◆ Avoid hypotonic fluids as glucose containing solutions (glucose 5%) & half normal saline.
- ◆ Avoid hypervolemia.
- ☞ Ringer acetate & lactate are not contraindicated in neurosurgical patients.

#### 7. **Glucose:** Avoid hypo & hyperglycemia ... Both are equally injurious.

#### 8. **Temperature:** Avoid fever as every ↑1°C above 37°C → ↑↑ CMR by 7%.

#### 9. **Surgical intervention:**

Intrathecal drainage (20-40 ml of CSF), decompression craniotomy or evacuation of hematoma if present.

#### 10. **PHYSIOTHERAPY + OUT OF BED:**

مهمين جدا في العيانيين دول لأنهم ييموتوا من المخ أو chest infection أو DVT

☞ Failure of conscious level to improve → Do EEG & MRI with diffusion & consider sub-convulsive fits.

الرئين هتعمله عشان توفر ع العيان لما يخرج من الرعاية مش أكثر

### **Polyurea in neurosurgical patient**

- ◆ Keep an eye on Na<sup>+</sup> level.
- ◆ Differential diagnosis → Diabetes insipidus or Cerebral salt wasting.
- ◆ Plasma osmolarity =  $(2 \times Na) + \frac{Glucose}{18} + \frac{BUN}{2.8} \rightarrow (2 \times 140) + \frac{90}{18} + \frac{14}{2.8} = 290 \text{ mosm/kg H}_2\text{O}$ .
- ◆ Target Na level in neurosurgical patient is 160.

#### **Diabetes insipidus**

- ↑ serum Na<sup>+</sup>
- Give Minirin (desmopressin) tablets up to 4 tablets every 8 hrs ...  
Or nasal spray: - No nasal clots  
- Kept in a refrigerator  
- Package is upright on administration.  
Sublingual tablets are also available.

#### **Cerebral salt wasting**

- ↓ serum Na<sup>+</sup>
- Give Astonin-H (fludrocortisone): 0.2 mg / 24 hrs.
- Investigations: 24 hr urine for osmolarity & Na level.



- Autoregulation of all organs is MAP 50-150 mmHg except the kidneys → 80 - 180 mmHg.  
يعني ده range of MAP اللي الـ organ يقدر يتعامل معاه من غير ما يحصله damage ... يعني لو الضغط زاد في الرينج ده يحصل vasoconstriction في الـ organ vessels فيقلل الدم اللي واصله وميحصلوش damage زي hemorrhage ... أو لو الضغط قل يحصل فيه vasodilatation فيزود الدم اللي واصله وميحصلوش ischemia .
- Renal autoregulation depends on prostaglandins → Don't give NSAID in hypotensive anesthesia as it will interfere with renal autoregulation .
- Sedation of neurosurgical patient: Precedex, Haloperidol, Seroquel or Resperidal.

### **Early tracheostomy**

1. GCS < 6 → dilated fixed أو ميكونش بيموت
2. Bronchoscopy showing trachea مهيئة
3. Excessive secretions with inadequate cough
4. Morbid obese with inadequate cough

### **Correction of hyponatremia**

♦ Calculate the volume & the duration to get the Rate of infusion.

#### **1. Volume**

- ♦  $\text{Na}^+$  deficit (mEq) =  $(130 - \text{current Na}) \times \text{Total Body Water}$
- ♦ Calculate the required volume according to Na concentration in used solution.
- ☞ TBW in liters = 50% of body weight in females ... 60% of body weight in males.
- ☞ e.g, Male 70 kg, serum  $\text{Na}^+$ : 110 mEq/L & using normal saline for correction:  
 $\text{Na}^+$  deficit (mEq) =  $(130 - 110) \times (0.6 \times 70) = 20 \times 42 = 840 \text{ mEq}$ .  
Normal saline contains 154 mEq in each liter → So, volume needed =  $840/154 = 5.5 \text{ liters}$ .

#### **2. Duration**

- ♦ 0.5 - 1 mEq/L/hr to avoid central pontine demyelination → quadriplegia, dysarthria & coma.
- e.g, serum  $\text{Na}^+$ : 110 → Deficit =  $130 - 110 = 20 \text{ mEq/L}$  → Duration:  $20/0.5 = 40 \text{ hours}$ .

#### **3. Rate of infusion:**

5.5 liters over 40 hours =  $0.137 \text{ L/hr} = 137 \text{ ml/hr}$ .

- ♦ Manifested (i.e. DCL): use hypertonic saline.
- ♦ Not manifested (i.e. conscious): use normal saline.
- ♦ Assess  $\text{Na}^+$  level every 8 hours.

### **Correction of hypernatremia**

- ♦ Normal  $\text{Na}^+ \times \text{Normal body water} = \text{Current Na}^+ \times \text{Current body water}$
- ♦ Water deficit = Normal body water - Current body water
- ♦ Methods of correction:
  - Enteral: Distilled water → the same calculated volume.
  - IV (for NPO patients): Glucose 5%. → the same calculated volume.  
or Half normal saline → double the calculated volume.
  - Don't forget to give the maintenance.
  - أهم سبب لفشل التصليح إن المحاليل مش بتتعلق أو اتعلقت محاليل غلط عشان كده لازم ترقم الأرايز وتعلقهم بنفسك وتفهيم التمريض إنها هنتوزع على الشيفت كله وتيجي تلاقهم خلاصين.
- ♦ Rate of correction: 0.5 - 1 mEq/hr or over 48 - 72 hours ... Rapid correction may lead to brain edema.
- ♦ Assess  $\text{Na}^+$  level every 8 hours.

# ISCHEMIC STROKE

## Initial Management → ABC

### a) Airway

- ♦ Indications of intubation: - Bulbar symptoms + pneumonia - GCS < 8
- ♦ Gradual initiation of feeding with **clear water** + **witnessed** to avoid aspiration.  
Consider semi-solids زبادي → better swallowed than liquids.

### b) Breathing

- ♦ Assessment of ventilation.

### c) Circulation

- ♦ BP 210/110 is accepted in the 1<sup>st</sup> 24 hours → لو العيان ماشي علي دوا ضغط وقفه
- ♦ BP 180/100 is accepted in the next 48 hours.
- ♦ If SBP < 100 → start levophed infusion.
- ☞ Target SBP in **Hemorrhagic stroke** → 150 mmHg with IV AGENTS IMMEDIATELY.

## Further Management

### If there is weakness in the 1<sup>st</sup> 4 hours:

- ★ Do urgent MRI with diffusion → If ischemic stroke → TPA.
- ★ If MRI is not available → Do CT brain to exclude hemorrhagic stroke, take a consent for hemorrhagic infarction & give TPA.
- ★ Assessment of conscious level every 4 hours.
- ★ In case of sudden deterioration of conscious level → Give mannitol (1 gm/kg) + Lasix (40 mg) → Then CT brain: If there is midline shift → Consider decompressive craniotomy.  
بنتخاق عليها عشان تلحق العيان قبل ما يحصل conization .
- ★ Search for the cause after stabilization (ABC)  
Old patient: lipid profile, Echo & carotid duplex ...  
If carotid duplex is positive → Do CT cerebral angiography + vascular consultation.  
Young patient → Autoimmune profile,  
Protein C & S & anti-thrombin III after 3 months (↑ in acute phase).
- ★ PHYSIOTHERAPY + OUT OF BED → مهمين جدا في العيانيين دول .

## Medications

- ① Statins → Ator 80 mg or Crestor 40 mg.
- ② Aspocid 150 mg + Prophylactic anti-coagulant (clexane 40 mg SC/24 hrs).  
or Aspocid 300 mg only.

☞ In case of recurrent stroke → Aspocid + Plavix + Prophylactic anti-coagulation.

☞ If 1<sup>st</sup> time TIA → Aspocid, 2<sup>nd</sup> time → Plavix, 3<sup>rd</sup> time → Aspocid + Plavix.

- ③ Anticoagulation: In patients indicated for therapeutic anti-coagulation (prosthetic valve, AF, DVT, etc) → Stop antiplatelet drugs & start **ORAL ANTICOAGULATION** as follows:  
Minute infarction → After 3 days.  
Moderate infarction → After 1 week.  
Massive infarction → After 2 weeks.
- In patients with strong indication for therapeutic anticoagulation; e.g, recent pulmonary embolism, **PARENTERAL THERAPEUTIC** anti-coagulation can be started after half the previously mentioned durations according to the infarct size.

- **PROPHYLACTIC** anti-coagulation can be started early especially in minute & moderate strokes.
- Heparin is better than clexane being short-acting with a specific antidote in case of development of hemorrhagic infarction on top of ischemic one.
- CT brain is indicated 24 & 72 hours after starting anti-coagulation to exclude development of hemorrhagic infarction.

📄 Brain stimulants have no role ...

Cerebrolysin is questionable & contraindicated in patients with renal impairment or convulsions.

📄 In **hemorrhagic stroke, brain contusion & intracranial hemorrhage** → prophylactic anticoagulation can be started after 4 days, meanwhile the patient should be maintained on pneumatic cuff. While as therapeutic anti-coagulation can be started after at least 14 days up to 6 weeks.

# ACUTE KIDNEY INJURY

## RIFLE classification قديم

- **Risk** → ↑↑ creatinine by 50% of baseline level (1→1.5) , UOP < 0.5 mL/kg/hr for 6 hours.
- **Injury** → ↑↑ creatinine by 100% of baseline level (1→2) , UOP < 0.5 mL/kg/hr for 12 hours.
- **Failure** → ↑↑ creatinine by 200% of baseline level (1→3) , UOP < 0.3 mL/kg/hr for > 24 hours.
- **Loss** → Complete loss of kidney function (anuria) for > 4 weeks ... "necessitates dialysis".
- **End-stage kidney disease** → Complete loss of kidney function (anuria) for > 3 months.

## KDIGO staging → Kidney Disease Improving Global Outcomes

- **Stage 1** → ↑↑ creatinine by  $\geq 0.3$  mg/dL within 48 hours, UOP < 0.5 ml/kg/hr for 6-12 hrs or ↑↑ creatinine 1.5 - 1.9 times baseline over 7 days.
- **Stage 2** → ↑↑ creatinine to 2.0 - 2.9 times baseline or UOP < 0.5 ml/kg/hr for  $\geq 12$  hrs.
- **Stage 3** → ↑↑ creatinine to 3.0 times baseline, UOP < 0.3 ml/kg/hr for  $\geq 24$  hrs, anuria for  $\geq 12$  hr or ↑↑ creatinine to  $\geq 4.0$  mg/dL or initiation of renal replacement therapy.

$$\text{Creatinine clearance} = \frac{(140 - \text{age}) \times \text{body weight}}{72 \times \text{serum creatinine}} \times 0.85 \text{ if female}$$

N.B: Anuria for > 6 hours despite Lasix infusion → creatinine clearance is considered below 10 whatever may be serum creatinine.

## High risk patients for AKI

- **عيان** → Chronic renal impairment, hepatic patients.
- **عمليات** → Vascular surgery, biliary surgery, massive debridement.
- **صبغة** → Urographine, massively crushed limb, bilirubin (obstructive jaundice).
- **Sepsis & Trauma.**
- **Nephrotoxic Drugs.**

## Indications of dialysis

Clinical " <b>Only in renal patients</b> " → Major Systems	Laboratory
1. CNS: DCL (uremic encephalopathy). 2. CVS: Pericarditis (pericardial rub). 3. Respiratory: Pulmonary edema. 4. GIT: Persistent vomiting.	1. pH < 7.1 or $\text{HCO}_3^- < 10$ 2. Refractory hyperkalemia > 6.5 صلح 1 و 2 لحد ما العيان يغسل 3. Creatinine > 10 or rising by > 1 per day (disregard in critical patients). 4. Urea > 200

### **Dialysis in unstable patients:**

- Don't rush to dialysis in unstable patients unless there is a profound indication:  
Severe acidosis, resistant hyperkalemia or pulmonary edema.
- High risk consent.
- Increase the vasopressor dose till SBP 160.
- مكنة بتسحب ببطء وتكون واقف وهو بيتسحب ع المكنة
- Single session then reassess.



## Intrinsic Renal

### Management

- 1 Check balance/4 hrs & restrict fluids to avoid congestion.
- 2 Stop potassium supplementation & correct cautiously if hypokalemic.
- 3 Daily calculation & documentation of creat. clearance (يُسجل في ورق العلاج). KIDGO stage 3 = creatinine clearance  $< 10$ .
- 4 Stop nephrotoxic drugs unless lifesaving → e.g, antibiotic on culture → given on dialysis.
- 5 Abdominal ultrasound to detect backpressure changes.
- 6 Diuretics: 20-40 mg shots over 5 minutes → 60-120 mg over 20 minutes → 160-200 mg over 40 minutes.  
- Start with high doses if the patient is already on diuretics.  
- Patients who have partial but inadequate diuresis with bolus therapy should be treated with continuous infusion.  
- Patients who have no response to the maximum dose of bolus therapy should not be treated by continuous infusion.  
- Lasix infusion even in low dose is more effective than shots.
- 7 Albumin in anuric or oliguric patients on diuresis with hypoalbuminemia  $< 2.5$  gm/dL.
- 8 Dialysis.
- 9 Work up of kidney in case of known CKD or persistently high creatinine level.

## Management of AKI

### Pre-renal

#### Exclude pre-renal causes

##### 1 Ensure adequate volume status:

1. Static measure → CVP.

Target CVP: 12 cmH<sub>2</sub>O in spontaneously breathing patients & 15 cmH<sub>2</sub>O in ventilated ones  
الذي محاليل ما دام مش hypoxic ولا cardiac بس أحرك  
حتى لو CVP موصلش للرقم ده.

2. Dynamic measures → Cardiometry, Echo & PPV.
3. ميزان خصوصاً العائنين اللي في بيتهم.

##### 2 Target MAP $> 65$ mmHg ( $> 85$ mmHg if HTN).

In case of high intra-abdominal pressure more than 15 mmHg → target MAP will be  $> 85$  mmHg.

##### 3 Perfusion:

1. Lactate
2. Capillary refill
3. Mixed venous  $SO_2 > 70\%$ ,  
Central venous  $SO_2 > 65\%$   
If less →  $\uparrow \uparrow$  Hb  $> 9$ .  
If still low → Dobutamine infusion  
لو ضغطه يسبح
4. CO<sub>2</sub> gap (central venous CO<sub>2</sub> - arterial CO<sub>2</sub>):  
If  $> 6$  mmHg → bad sign.

### Post-renal

#### Exclude post-renal causes

- 1 Check the urinary catheter for obstruction.  
سلك القسطرة أو غير ها.. ولو في conduit التأكد إنه مشغل (خائب المسالك).
- 2 Perform abdominal ultrasound to detect backpressure changes (exclude stone).
- 3 Palpate the bladder (even if no catheter obstruction) especially after TURP or trauma as urethral injury may cause a false track → Ultrasound will show distended bladder with no renal backpressure changes → managed by suprapubic cystocatheter.

## Renal protection against dyes:

1. Stop NSAIDs 24 hours before administration
2. If fluid responder or fasting: Normal Saline 1 ml/kg/hr for 6 hours before and 6 hours after
3. Bicarb has no role in prevention of nephrotoxicity nor does any other drug.

### Hidonac (high dose N-acetyl cysteine IV)

- Indications:**
- Paracetamol toxicity (common in ICU in pediatrics).
  - Liver cell failure.
  - Highly elevated liver enzymes.
  - Tridil tolerance.
  - Used to have a role in renal protection against dye.

- Dose:**
- 150 mg/kg for the first hour.
  - 12.5 mg/kg/hr for 4 hours.
  - 6.25 mg/kg/hr for 24 hours.

## Hyperkalemia

☞ Serum  $K^+ > 5.5$  mEq/L.

☞ Clinical picture:

1. Muscle weakness
2. ECG changes: hyperacute T ( $> 2$  LS in chest leads & 1 LS in limb leads), prolonged PR & wide QRS.
3. Finally cardiac arrest in diastole.

### ☞ Anti-hyperkalemic measures

1. Stop potassium intake.
2. Protect the heart → 3 ampoules of calcium gluconate or 1 ampoule of calcium chloride → “CVL”.
3. ↑↑ Intracellular shift of potassium:
  - ♦  $\beta_2$  agonist: farcolin (salbutamol).
  - ♦ Alkalosis: metabolic ( $NaHCO_3$ ) & respiratory if ventilated (hyperventilation).  
N.B, For every 0.1 decrease in pH → K increases by 0.8.
  - ♦ Glucose-insulin: 1-2 units of insulin added to 5 gm glucose  
= 10 - 20 IU to 200 ml of glucose 25% **bolus** every 6 hours جري المحلول ع الآخر عشان يجيب نتيجة .
4. ↑↑ Potassium loss:
  - ♦ Lasix shots up to infusion as before.
  - ♦ Potassium chelating agents (sorbisterit) → very effective.
  - ♦ Dialysis if  $K^+ > 7$  + ECG changes.

## Potassium Replacement Therapy

- 5 ampoules/50 ml saline → Rate 15-20 ml/hr “central line”.
- Maximum rate of peripheral potassium infusion is 0.8 mEq/hr to avoid thrombophlebitis.
- Oral forms: 1 tab = 8 mEq ... 25 ml syrup = 10 mEq → Dose 45 ml/ 8 hrs.  
Avoid oral potassium in gastritis, hematemesis & peptic ulcer.
- Chronic hypokalemia → Give 10 ampoules then reassess:  
If minimal rise → Give another 10 ampoules... If  $> 4$  → stop  $K^+$  infusion.
- Maximum dose → 24 ampoules in 24 hours.
- Hypomagnesemia is a common cause of hypokalemia.
- Renal patients with hypokalemia: Cautious correction “2 ampoules then reassess” → Target: 3.5 mEq/L.
- Potassium level: Intracellular: 135 ... Extracellular: 3.5-5.5

## لما تركيب ماهوركر لعيان End-stage renal disease

← نظافة كتيبيير "disinfection".

➤ Site: Rt IJV > Femoral > Lt IJV > Subclavian.

لو كله مقفول ← intrahepatic catheter (intervention radiology)

← شبكة واحدة في subclavian vein بتعمل stenosis 50% فارحم أم العيان D:

← لو السونار مطلع grade III nephropathy قول للعيان يعمل قرار في أسرع وقت عشان يعمل الوصلة وميتأخرش لأنها أصلا بتشتغل بعد فترة وخلال الشهر ده هيكون اتشك في كل حنة في جسمه ومبقاش نافع يعمل وصلة خلاص .

## Intra-abdominal pressure

☞ Intra-abdominal pressure is very important because renal perfusion pressure = MAP – (2 X IAP).

☞ Suspect high IAP in the following conditions:

- Major trauma/ burn
- Abdominal surgery with tight closure
- Liver tear closed with packs
- Tense ascites
- Massive transfusion

☞ If IAP is high (> 15 mmHg) a higher MAP is desirable (80-85 mmHg).

☞ نقيسه ازاي: والعيان supine ... احقن 15-20 سم ملح في قسطرة البول ووصلها بجهاز ويريد .

## Rhabdomyolysis

♦ **Diagnosis:** Rise of CK level 5 to 10 times above normal value.

CK > 5000 IU/L increases the risk of AKI.

♦ **Common Causes:**

- Direct muscle trauma, burn, electrocution, seizures, hyperthermia, hypothermia & reperfusion injury.

♦ **Treatment:**

- Normal saline or Ringer lactate infusion at 3-5 ml/kg/hr till CK level decreases.  
عينك على hypoxia & cardiac condition UOP ← لو فيهم مشاكل قلل المحاليل دي .
- Target UOP > 100 ml/hr.
- If normo or hypervolemic → Mannitol 12.5 gm/ 6 hrs or Lasix can be given.
- If acidotic → Give half normal saline + 50 mEq NaHCO<sub>3</sub> to every liter at a rate of 125 ml/hr until urinary pH > 6.5 or serum pH > 7.5



# CHRONIC KIDNEY DISEASE

## Investigations

1. **Ultrasound** → To detect the grade of nephropathy.
2. **Albumin/Creatinine ratio** → Presence of albumin in urine indicates renal disease → treated by ACEI, ARBs or CCB.
3. **Parathormone level** → ↑↑ in case of hypocalcemia (secondary hyper-parathyroidism).
4. **Iron profile.**
5. **Electrolytes:**  $K^+$ ,  $Na^+$ ,  $Ca^{+2}$ ,  $PO_4$  &  $Mg^{+2}$ .
6. **Urine analysis:** ↑ casts in ATN, ↑ WBCs in interstitial nephritis, ↑ RBCs in vasculitis.
7. **Echo every 6 months** → to detect cardiomyopathy.

## Management

### 1. Anemia ( $Hb < 10$ gm/dl).

In case of ↓ iron level → Give eprex (erythropoietin) + ferosac (iron).

In case of normal iron level or blood transfusion → Give eprex only.

### 2. Hypocalcemia:

In case ↓ Ca with normal  $PO_4$  ( $Ca \times PO_4 < 50$ ) → Give Calcimate + one alpha(vitamin D).

In case ↓ Ca with high  $PO_4$  ( $Ca \times PO_4 > 50$ ) → Give Calcimate only (500 mg /24 hrs) .

☞ For each ↓ 1 gm of albumin below 4 gm/dl → Calcium decreases by 0.8 .

### 3. Statins

#### **Nephrotoxic Drugs commonly used in ICU:**

- |                   |                  |              |
|-------------------|------------------|--------------|
| - Amikacin        | - Amphotericin B | - Vancomycin |
| - NSAIDs          | - Colistin       | - ACEI       |
| - Cerebrolysin ?? | - Aldactone      | - Dye        |

**Cerebrolysin & aldactone:** Stop in case of creatinine  $> 2.5$  .

**ACEIs & ARBs:** Follow up creatinine → Stop if rising  $> 50\%$  of baseline otherwise should be continued.

☞ In case of generalized edema → give diuretics whatever its impact on kidney function

☞ AV fistula or after MRM → الزق بلاستر بطول ذراع العيان إنه ممنوع قياس الضغط أو تركيب كانيولات ع الناحية دي

#### **Medications commonly associated with acute tubular necrosis:**

- Aminoglycosides.
- NSAIDs.
- ACEIs & ARBs.
- Amphotericin
- Others: Iodinated contrast

#### **Medications requiring dose adjustment or cessation in AKI**

- Analgesics: morphine, pethidine, gabapentin, pregabalin.
- Digoxin
- LMWH (clexane)
- New oral anti-coagulants
- Antifungals: fluconazole.
- Antibiotics (most of them).
- Oral hypoglycemic drugs: sulfonylureas, metformin.
- Antivirals: acyclovir.
- Lithium
- Antiepileptics: lamotrigine.

### **Malignant Hypertension**

➤ **Diagnosis**: Exclude secondary causes:

Thyroid profile, cortisol level, urinary vanillyl-mandelic acid, cholesterol & renal duplex.

➤ **Treatment**: Maximum doses of dual oral anti-hypertensive drugs + Tridil infusion.

	Preferred in	Avoided in
Beta blockers	IHD N.B, IHD + bronchial asthma → give BB.	Bronchial asthma Decompensated liver disease
ACEIs & ARBs	Diabetes → ↓proteinuria IHD → ↓remodeling	Renal impairment: stop if rising creatinine > 50 %

CCBs: Norvasc (amlodipine).

Epilat (nifedipine) → in severe persistent hypertension (cautious monitoring of BP).

Alpha blockers: Minipress (prazosin): 1-6 mg / 8 hrs.

Cardura (doxazosin): 2-16 mg / 24 hrs.



# DIABETIC KETO-ACIDOSIS

♦ Usually: type 1 DM, missed dose, eats a lot.

**Risk factors** → Trauma - Surgery - Infection - Pregnancy.

## Clinical picture

- **CNS** → Drowsy or comatose.
- **CVS** → Tachycardic with borderline blood pressure.
- **Respiratory** → Tachypnic with acetone odor (Kussmaul breathing).
- **GIT** → Vomiting with abdominal colic (acute abdomen).
- **Renal** → Polyuria.

## Diagnosis

- **RBS** > 250 mg/dl N.B: 25% of cases may be euglycemic.
- **Acetone in urine** → Positive N.B: may be negative.
  - Acetoacetic acid appears late & disappears late (detectable in urine & blood).
  - β-hydroxybutyric acid appears early (detectable in blood only), وغير موجود في مصر
- **ABG** → Metabolic acidosis with **high anion gap**.

## Management

### 1) ABC

### 2) FLUIDS

<u>Volume</u>	<u>Mechanism of action</u>
<p>➤ Adults:</p> <p>1000 ml .. 30 min.</p> <p>1000 ml .. 1 hour</p> <p>500 ml .. 1 hour</p> <p>Then 250 ml for every hour after that guided by fluid status &amp; UOP.</p> <p>➤ Pediatrics: Give 20 ml/kg of normal saline as a bolus. Give another bolus in shocked patients. Then give double the maintenance.</p>	<p>1. Correction of dehydration &amp; improvement of perfusion.</p> <p>2. Dilution of anti-insulin hormones.</p> <p>3. ↑ sensitivity of insulin receptors.</p>
<u>Type</u>	
<p><b>According to corrected Na<sup>+</sup> level → Serum Na<sup>+</sup> + (1.6 x <math>\frac{RBS - 100}{100}</math>)</b></p> <p>As each 100 mg/dl of blood glucose above 100 leads to a decrease of Na<sup>+</sup> level by 1.6.</p> <p>e.g, serum Na<sup>+</sup>: 130, RBS: 500 → Corrected Na<sup>+</sup> = 130 + (1.6 x <math>\frac{500 - 100}{100}</math>) = 130 + 6.4 = 136</p> <p>☞ This is because hyperglycemia draws water from the intracellular space &amp; creates a dilutional effect on plasma Na<sup>+</sup>.</p> <p>➤ If corrected Na<sup>+</sup> level is high → give half normal saline (If not available add 250 ml of glucose 5% or distilled water + 250 ml saline).</p> <p>➤ If normal or low: give normal saline.</p> <p>➤ When RBS decreases below 250 mg/dl → give 1-2 ml/kg/hr glucose (5% or 10% or 25% according to glucose level) + normal saline + half dose of insulin.</p> <p>☞ The volume of infused glucose should be subtracted from the deficit.</p>	

### 3) INSULIN

- ♦ Give a bolus of 0.1 unit/kg of regular insulin IV then 0.1 unit/kg/hr.
- ♦ Check RBS hourly.
- ♦ The blood glucose level should decrease by 70-100 mg/dl per hour.  
If > 100 → ↓ insulin infusion to ½ dose (0.05 unit/kg/hr).
- ♦ Resistant DKA, DKA in cardiac & renal patients → double the dose of insulin.
- ♦ في مصر → Rate of infusion =  $\frac{RBS}{100} \rightarrow \text{units/hr.}$
- ♦ In hypoperfused patients → peripheral RBS is less than central RBS by about 30-50 mg/dL  
فلو عيان على inotropes وإيدته ساعة وسكره واطي peripheral قيسه من CVL.

### 4) POTASSIUM

- Give 10 - 20 mmol/liter (ampoule / saline bottle).
- If serum  $K^+ < 3.3 \rightarrow$  Hold insulin & correct hypokalemia first.
- Serum  $K^+$  & ABG should be checked every 4 hours.

### 5) BICARBONATE

- Given only if pH < 7 ... إلا لو كنت في الطل اديله أمبولين وحصل خير

### 6) TREATMENT OF PRECIPITATING FACTOR

- e.g, Control of infection: medical & surgical → e.g, debridement of diabetic foot.
- N.B. DKA + DCL / proptosis → suspect Mucormycosis → CT brain to diagnose → treated by fungizone (amphotericin B).

#### **DKA in cardiac & renal patients**

- Give fluids according to fluid responsiveness → Static (CVP) & Dynamic (Cardiometry, Echo & pulse pressure variation).  
قيس الـ CVP بعد كل 200 سم.
- Double the dose of insulin.
- Congested renal patient → Dialysis + fluid administration. اغسله وادي المحاليل أثناء الغسيل
- Congested cardiac patient → Lasix.
- Expected to be resistant because treatment of DKA depends mainly on fluids & not insulin.

#### ❖ Resolution of DKA امتى بنقول ان العيان فك؟

- ♦  $HCO_3^- > 18$  for  $\geq 2$  readings
- ♦ Acetone-free من القسطرة نفسها مش من كيس جمع البول (أسيتون قديم من الأول)

#### ❖ When to Shift to fixed insulin doses? After adequate oral intake:

- ❶ 2/3 of daily requirement of regular insulin → **Mixtard**: 2/3 in the morning & 1/3 at night  
± oral hypoglycemic ...

Or ❷ **Mixtard** 0.5 - 0.75 unit/kg/day ± oral hypoglycemic

Or ❸ **Lantos** single dose at night + 3 doses of **Actrapid** before meals.

في أوروبا والدول المتقدمة فقط عشان الـ calories بتكون محسوبة في كل وجبة ... البكاورت مفيهوش 4 شكات D:

❖ Lantos can be continued in DKA.

❖ Mixtard is taken after resolution of DKA. بس يبدأ من ثاني يوم الصبح

Mixtard: Short-acting + Long-acting معكر

Lantos: Long-acting

Actrapid: Short-acting شفاف

### Hyperglycemic hyperosmolar non-ketotic coma

- Occurs in old patients without ketoacidosis.
- Usually in type 2 DM.
- Ketoacidosis may occur very late (starvation ketosis).
- Diagnosis → By plasma osmolarity > 320 (hyper-osmolarity).  
Plasma Osmolarity =  $(\text{Na} \times 2) + (\text{Glucose}/18) + (\text{Urea}/2.8)$
- Management :
  - Fluid resuscitation 15-20 ml/kg/hr up to 50 ml/kg/hr in severe dehydration guided by fluid status & UOP (the usual deficit is 9 - 12 liters).
  - Insulin + Potassium infusion as in DKA.

# HEPATIC PATIENT

## CHILD classification:

	1	2	3
<b>Encephalopathy</b>	Absent	Minimal	Severe
<b>Ascites</b>	Absent	Minimal	Moderate or severe
<b>Serum bilirubin</b>	< 2 mg/dl	2-3 mg/dl	> 3 mg/dl
<b>Serum albumin</b>	> 3.5 g/dl	3 - 3.5 g/dl	< 3 g/dl
<b>INR</b>	< 1.7	1.7 - 2.2	> 2.2

5 - 6 points → Child A (well-compensated).

7 - 9 points → Child B (significant compromise).

10 - 15 points → Child C (decompensated) → Risk of intra-operative mortality is > 40%

→ Inotropes from the start لو ضغطه وقع المحاليل مش هتجيب نتيجة

### Patients with chronic liver disease at home:

- ↑↑ liver enzymes → Give silymarin/ 8 hrs → cell membrane stabilizer.
  - ☞ Silymarin plus = silymarin + N-acetyl cysteine (contraindicated in pregnancy).
- ↑↑ bilirubin → Give ursofalk tablet/ 8 hrs or قرصين الصبح و قرص بالليل
  - Assess direct/total bilirubin ratio + IHBR dilatation for possibility of obstructive jaundice → for ERCP.
- Give oral lactulose → Target is 2-4 motions/ day.
- In case of ascites or edema → Give aldactone or lasilactone according to severity & targeting ↓↓ weight.
  - Aldactone in hepatic patients can be given in a high dose (100 - 400 mg/day).
  - Aldactone is contraindicated if serum creatinine > 2 .
- Patients with history of hepatic encephalopathy → Give Gastrobiotic 550 mg / 12 hrs.
- Cirrhotic patients with history of SBP, GIT bleeding, ascites (ascitic fluid protein < 1.5 gm/dl) or renal impairment → Give Cipro 750 mg /week to prevent SBP.
- In case of anemia → Investigate for occult blood in stool → If positive: consider upper GI endoscopy.

## 6 Major Problems in Hepatic patients

### ① Hepatic Encephalopathy

- ♦ Clinical picture: Flapping tremors, disorientation, ↑↑ ammonia ...
  - لو عنده flapping tremors متستعجلش في خروجه حتى لو كان oriented .
- ♦ Lactulose enema added to oral lactulose.
  - بعد ما تتحقق مش بنفضيها عشان هتطلع clear وملهاش لازمة ... بنسيبها تعمل distension للقولون ويفضيها لوحده فيخرج الـ contents بتاعة القولون ... اتأكد إن التمريض بيعملها فعلاً.
- ♦ Hepamerz (L-orithine L-aspartate): combines with ammonia forming urea which is excreted by the kidney.
  - 4 - 8 ampoules once daily (no intervals) → maximum 1 amp /hr ...
  - Contraindicated in renal impairment with serum creatinine > 3 (allowed in hemodialysis).
- ☞ Consider CT brain if not recovering within 24-48 hrs of treatment..

## 2 Hematemesis

### 1. ABC.

Border line conscious level with hematemesis is an indication for intubation to avoid aspiration.

Two wide bore cannulae, CBC and cross matching for blood & plasma transfusion  $\pm$  platelets.

### 2. Gastric wash with cold saline & adrenaline till it becomes clear.

In non-intubated patients: 250 ml at a time to avoid regurgitation & aspiration.

look for air under diaphragm  $\leftarrow$  perforated DU لازم اللي بياخده يطلعه ... لو مش بيطلعه يبقى احتمال يكون

### 3. 3<sup>rd</sup> or 4<sup>th</sup> generation cephalosporin for 5 days due to high incidence of SBP with bleeding varices !

### 4. PPI infusion: Controloc (pantoprazole) or Nexium (Esomeprazole)

80 mg IV shot then 8 mg/hr  $\rightarrow$  Then: Controloc 1 vial / 50 ml  $\rightarrow$  Rate: 10 ml/hr (stability is 5 hrs).

Or: Nexium 2 vial / 50 ml  $\rightarrow$  Rate: 5 ml/hr (stability is 10 hrs).

If no available syringe pump  $\rightarrow$  vial 40 mg/ 6 hrs.

Continue till no more bleeding or upper GI intervention.

### 5. Sandostatin (octreotide) IV for 3 - 5 days $\rightarrow$ $\downarrow$ portal hypertension.

25 - 100  $\mu$ g bolus followed by 25 - 50  $\mu$ g/hr for 3 - 5 days or ampoule SC / 6-8 hrs. (amp=100  $\mu$ g).

### 6. Coating drugs: Mucosta, Maalox & Gaviscon $\rightarrow$ have no role with PPI.

### 7. Upper GI endoscopy: after stabilization $\rightarrow$ Band ligation, sclerotherapy or surgical control: Sengstaken tube.

### 8. If proved to be DU (not bleeding varices): Stop antibiotics & sandostatin,

Do H.pylori Ag in stool  $\rightarrow$  treated by triple therapy: metonidazole, axmoxycillin & clarithromycin.

In some cases, hematemesis may be due to leaking aortic aneurysm. Bleeding comes out through a fistula with the esophagus or the stomach after rupture  $\rightarrow$  detected on upper endoscopy.


## 3 Hepatorenal Syndrome

Hepatic patient (cirrhosis & ascites) with:

1. Rising creatinine  $> 1.5$  with no improvement after 2 days of volume expansion using albumin & diuretic withdrawal
2. Absence of shock
3. No current use of nephrotoxic drugs
4. Normal renal ultrasound.

### Management : (same as AKI)

- Exclude post-renal  $\rightarrow$  Flush the catheter.
- Exclude pre-renal  $\rightarrow$  Ensure adequate fluid state (by static & dynamic measures).
- Management of intrinsic renal (see AKI) PLUS :
  1. Albumin: 2 vials/12 hrs + Lasix.
  2. Splanchnic VC:
    - Midodrine ( $\alpha_1$  agonist) 7.5 mg (3 tablets)/ 8 hrs **PLUS** Sandostatin (IV infusion or SC shots).
    - OR** Glypressin: Loading: 1 vial / 50 ml over 1 hour or direct IV shot.  
Maintenance: 1 vial / 50 ml  $\rightarrow$  rate: 8 ml/hr.
    - OR** Levophed targeting  $\uparrow\uparrow$  MAP by 15 mmHg from baseline.
  3. Tapping in case of  $\uparrow\uparrow$  intra-abdominal pressure.
  4. Target Creatinine  $< 1.4$  mg/dl

 Sandostatin & glypressin are relatively contraindicated in patients with IHD & absolutely contraindicated in acute coronary syndromes.

 Glypressin infusion is more effective than direct IV shot.



#### 4 Spontaneous Bacterial Peritonitis

##### Diagnosis :

1. Ascitic fluid analysis → Neutrophils > 250 cell/cmm + Culture & sensitivity.
2. ↑TLC, ↑CRP, fever & tense ascites with abdominal tenderness.

##### Management :

1. Albumin: 1.5 gm/kg (9 vials) on day1 then 1 gm/kg (6 vials) on 3 days.
2. Cefotaxime (claforan),  
Shift to Tienam, Meronem or Tazocin in case of no improvement after 48 hours,  
hemodynamically unstable, hospitalized for 48 hrs or on antibiotics for 3 days.
3. Stop β-blocker عدو عيائين الكبد

#### 5 Hepato-adrenal Syndrome

Any hepatic patient on inotropic support (even minimal doses) should be supplemented with hydrocortisone 50 mg/ 6 hrs.

#### 6 Hepatopulmonary Syndrome

Dyspnic in semi-sitting.  
Wake the patient up flat (platypnea).



##### ➤ Indications of Albumin:

1. Hepatorenal syndrome.
2. Spontaneous bacterial peritonitis.
3. Hypovolemia, burn (> 50%) & septic shock in case of extensive resuscitation (30ml/kg) → Albumin 5%.
4. Plasmapheresis.
5. Acute kidney injury with hypoalbuminemia.
6. Ovarian hyperstimulation syndrome with hypovolemia (in volume depletion otherwise use crystalloids).
7. Tapping: after the 5<sup>th</sup> liter → Give 1 vial for each 1 liter.
8. Liver transplantation to restore lost volume or drain losses (albumin 5%).
9. Nutritional hypo-albuminemia if serum albumin < 2 gm/dl.
10. Moderate pleural effusion with hypo-albuminemia → Give albumin + Lasix.

##### ➤ Stop β-blocker in hepatic patient with:

1. Hepatorenal syndrome.
  2. SBP.
  3. Refractory ascites.
  4. Systolic BP < 100 mmHg or MAP ≤ 82 mmHg.
  5. Serum Na<sup>+</sup> < 120 mEq/L.
- These conditions → ↓cardiac reserve → ↑mortality.

##### ➤ Indications of tapping:

1. Respiratory distress (even if associated with encephalopathy).
2. Hepatorenal syndrome to ↓ IAP → ↑ renal perfusion.

➤ **Hepatic patient with massive pleural effusion** → pig tail is more preferred than chest tube due to poor healing after removal.

➤ Albumin 20% vial → 50 ml containing 10 gm of albumin.

Albumin 5% → prepared by adding 2 vials of albumin 20% to 400 ml Ringer.

## IV FLUIDS

mEq/L	Normal saline	Ringer	Ringer lactate	Ringer acetate	Hypertonic saline 3%
Na <sup>+</sup>	154	147	130	130	513
Cl <sup>-</sup>	154	156	110	110	513
Ca <sup>+2</sup>	-	4.5	2	2.5	
K <sup>+</sup>	-	4	4.5	4.5	
Lactate	-	-	30	-	
Acetate	-	-	-	30	
Osmolarity	308	312	273	273	1026

### Fluid infusion sets

	Blood transfusion line	Venous line	Soluset
1 ml equals ?	10 drops	15 drops	60 drops
Number of drips/minute to give a certain volume/hour.	Target volume / 6 To give 120 ml/hr → 120/6 = 20 drops/min.	Target volume / 4 To give 100 ml/hr → 100/4 = 25 drops/min.	Target volume / 1 To give 100 ml/hr → 100/1 = 100 drops/min.

### How to select a vein for cannulation ?

1. Visible.
2. Palpable.
3. Straight.
4. Distal
5. Not over a joint.
6. Non-dominant hand.
7. Least painful area (medial side of forearm and ante-cubital fossa).

### Cannulation in pediatrics:

Visible or palpable → Blind cephalic → Blind basilic → External → CVL or venous cut down → Open CVL ... in emergency situations: intra-osseous.



- ☞ Decreasing blood sampling in ICU → ↓↓ the need to blood transfusion by 30-50%.
- ☞ Blood transfusion is required in ICU in the following:
  - Hb < 7 gm/dl.
  - Hb < 9-10 gm/dl in cardiac, pediatric & head trauma (TBI).
  - Hb drop > 50% in patients with high Hb, e.g, high altitude.
- ☞ Blood transfusion: 10 ml/kg → ↑ Hb: 3 gm/dl.
- Plasma transfusion: 15 ml/kg → ↑ PC: 30%.
- Platelet transfusion: 1 unit/ 10 kg → ↑ Platelet count: 5000.
- ☞ Arterial extension line → 3-5 ml ... Venous extension line → 7-10 ml.

☞ Bottles are either:

- Pressurized: مستطيلة → بتقضى لوحدها من غير ما تتخرم
- Non-pressurized: مدورة → بتتطبق ويفضل فيها fluid level عالي → محتاجة تتخرم أو يتركب فيها IV line with a unidirectional valve يدخل هواء في الازازة عشان يعادل الضغط زي فكرة الابرة اللي بتحطها في فيال البرفلجان .

☞ Blood volume: ml/kg.

Neonate: 95,      Pediatric: 85,      Adult male: 75,      Adult female: 65.

☞ Point of transfusion:

- $$\frac{\text{Actual Hct} - \text{Target Hct}}{\text{Actual Hct}} \times \text{Blood volume}$$

→ Assuming continuous replacement with fluids.

- 20 % of blood volume in fit adults, 10 % in extremes of age, cardiac or TBI patients.

→ If adequate replacement is not guaranteed. لو انت مش ضامن الجراح أو نايب صغير ع الحالة.

# DRUGS INFUSION

## Inotropes

### 1. Noradrenaline (Levophed)

- ◆ 2 forms → Monotartrate and bitartrate.
  - ◆ 3 available preparations (ampoules): 4, 8 & 16 mg.
  - ◆ How to prepare for infusion: 16 mg / 50 ml of glucose 5% = 0.3 mg/ml.
  - ◆ Infusion rate of 2.5 ml/hr = 0.1 mic/kg/min.
  - ◆ Maximum rate → 20 ml/hr = 0.8 mic/kg/min (maximum dose).
- بس الكفرة بيقولوا مغيث maximum dose لليفوفيد .  
يمكن نغدي ال maximum levo في عيان سنه صغير في hemorrhagic shock  
والدم جاي في السكة ... وفي حالات ال liver transplantation .  
كل الادوية بتتحل علي جلوكوز 5% ماعدا ال Epanutin لأنه بيتسبب في الجلوكوز .
- ◆ Indications:
    1. Septic Shock
    2. Cardiogenic Shock
    3. Hypovolemic Shock
    4. Pediatric warm septic Shock
    5. Pediatric cold septic shock (after failure of adrenaline).
    6. Spinal shock without bradycardia

### 2. Adrenaline

- ◆ 2 available preparations (ampoules): 0.25 mg & 1 mg.
- ◆ How to prepare for infusion: 3 mg / 50 ml of glucose 5%.
- ◆ Dose: 0.05-0.3 mcg/kg/min.
- ◆ Infusion rate: 7 ml/hr = 0.1 mcg/kg/min.
- ◆ In 70 kg patient, maximum dose is 21 ml/hr
- ◆ Indications:
  1. Persistent hypotension despite use of maximum levophed dose.
  2. Spinal shock with bradycardia
  3. Heart block (temporary till pacing)
  4. Pediatric cold septic shock syndrome
  5. Pediatric warm septic shock with BP controlled with levo but low mixed venous saturation (to improve COP & perfusion)
  6. Anaphylactic shock
  7. Status asthmaticus (1 mg/50 ml → Rate 1-2 ml/hr)
- ◆ Complications:
  1. Arrhythmogenic
  2. Lactic acidosis

### Dopamine

- ◆ How to prepare for infusion: 200mg / 50 ml of glucose 5%.
- ◆ Dose: 5-20 mcg/kg/min.
- ◆ 1 ml/hr = 1 mcg/kg/min.
- ◆ Indications:
  1. Pediatric septic shock (if other vasopressors are not available).
  2. Cardiogenic shock (in very rare situations ... if tachycardia or arrhythmias occur then stop).

مغيث حاجة اسمها dopamine renal dose

## **Dobutamine**

- ◆ How to prepare for infusion: 250 mg / 50 ml → 1 ml/hr = 1 mcg/kg/min.
- ◆ Dose: 1-20 mcg/kg/min.
- ◆ Indications:
  1. Low mixed venous saturation in Septic shock & Hb >10 gm/dl.
  2. Cardiogenic shock if BP can tolerate.

## **Other drugs infusion**

### **1. Tridil**

- ◆ 2 available preparations: amp 5 mg/ml & vial 1 mg/ml.
- ◆ How to prepare for infusion: 50 الفياال بيتسحب زي ما هو علي سرنجة
- ◆ Dose: 0.5-10 mic/kg/min.
- ◆ Infusion rate of 2 ml/hr = 0.5 mic/kg/min.  
Maximum rate (dose): 40 ml/hr (10 mcg/kg/min.).
- ◆ Indications:
  - AMI, ACS if hemodynamically stable (0.5-2 ml/hr), better than nitroderm patch.
  - Hypertensive crisis (tridil infusion+ dual oral antihypertensive at maximum dose).
  - Stroke: SBP 220 mmHg is accepted → Reduce SBP 20% after 24 hours.  
In case of hemorrhagic stroke → Target SBP is 140-150 mmHg.
  - Spasm of cervix & lower esophageal sphincter: 50 µg IV shot.
- ◆ Tolerance: after 24-48 hrs, effect is under question cause enzyme that metabolizes it into nitric oxide is saturated → nitrate free period for 10-12 hrs then resume.  
If resistant → N-acetyl cysteine IV → increases the enzyme

### **2. Glypressin**

- ◆ Available preparation: Ampoule = 1 mg.
- ◆ Dose in 70 kg patient: Loading 1 mg over 1 hr ... Maintenance 1 mg /6-8 hr.  
وينفع يتاخذ شوت في hepatorenal syndrome فقط .
- ◆ Indications:
  - Hepatorenal syndrome (infusion has better outcome).
  - Persistent hypotension despite use of maximum levophed & adrenaline doses.
  - Hematemesis.
- ◆ Contraindications:
  - Ischemic heart disease.

لو عيان عنده angina أخذ glypressin يقلب MI

### **3. Controloc**

- ◆ Dose: Loading 80 mg IV shot.  
Maintenance 8 mg/hr (1 amp/ 50 ml → Rate 10 ml/hr).  
If infusion is not available → 40 mg/6-12 hrs shots.
- ◆ Preparation according to type → for stability.  
Losec (omeprazole) → 5 hrs → So: 1 amp/ 50 ml.  
Controloc (pantoprazole) → 10 hrs → So: 2 amp/ml.
- ◆ Indications: Hematemesis.



# Pediatric Drugs Infusion

<i>Drug (inf = infusion)</i>	<i>Dose range</i>	<i>1ml/hr =</i>	<i>Add to 50ml</i>	<i>Notes</i>
<b>Adrenaline (inf)</b>	0.1-2.0 mcg/kg/min	0.1 mcg/kg/min	0.3 mg x wt	Intravenous, intraosseous. Always via CENTRAL line. In 5% dex or 0.9% N/S
<b>Aminophylline (inf)</b>	1 mg/kg/hr	1 mg/hr	x wt	Load 5mg/kg unless previous aminophylline. FIXED concentration mg/ml. Dose reduced infusion with age. Therapeutic range 10-20mg/l. Toxic tachycardia, jittery, seizures. Dilute in 5% dex
<b>Amiodarone (inf)</b>	5-15 mcg/kg/min	5 mcg/kg/min	15 mg x wt	Load 25mcg/kg/min for 4 hrs if no previous amiodarone. Baseline thyroid and liver functions. Only dilute in 5% dex. Not <600mcg/ml. Max 1.2g/24hrs. Baseline eye exam /TFT
<b>Dobutamine (inf)</b>	5-20 mcg/kg/min	10 mcg/kg/min	30 mg x wt	Vasodilatation and tachycardia. Central administration preferred if >5mg/ml.
<b>Dopamine (inf)</b>	5- 20 mcg/kg/min	10 mcg/kg/min	30 mg x wt	Central administration recommended. For peripheral administration 3x wt in mg (maximum 1.6mg/ml). Dilute in 5% dex or 0.9% N/S.
<b>Esmolol (inf)</b>	25-200 mcg/kg/min		x wt	Loading dose 500mcg/kg over 1 minute. Dilute to 10mg/ml through large bore vein. Dilute in 5% dex or 0.9% N/S. Recommended max concentration 20mg/ml (central administration). Extravasation risk.
<b>Fentanyl (inf)</b>	1-5 mcg/kg/hr	1 mcg/kg/hr	50 mcg x wt	Usual dose 1 - 3 mcg/kg/hr. Cumulative effect. Risk of rigid chest in neonates. Discuss with consultant. Dilute in 5% dex or 0.9% N/S.
<b>Furosemide (inf)</b>	0.1- 1 mg/kg/hr	0.2 mg/kg/hr	10 mg x wt	Dilute in 0.9% N/S only. For concentrated infusions 50 x wt in mg = 1mg/kg/hr= 1 ml/hr. Incompatible with most common infusions
<b>GTN (Glycerine trinitrate) (inf)</b>	1- 5 mcg/kg/min	1 mcg/kg/min	3 mg x wt	Tachyphylaxis may occur after 24 hrs. Recommended maximum concentration 400mcg/ml. In fluid restricted patients 1mg/ml centrally
<b>Heparin (inf)</b>	10-30 units/kg/hr	20 units/kg/hr	1000 units x wt	Use APTT to direct therapy Load 75units/kg. Start infusion at 20 units/kg/hr
<b>Insulin (inf)</b>	0.01- 0.2 u/kg/hr	0.05 u/kg/hr	2.5 units x wt	Dilute in 0.9% N/S only. Monitor glucose every 30 - 60 minutes at commencement.
<b>Isoprenaline (inf)</b>	0.02- 1 mcg/kg/min	0.2 mcg/kg/min	0.6 mg x wt	Neonates max 0.2 mcg/kg/min. Maximum for bradycardia 0.5mcg/kg/min. Up to 1mcg/kg/min for heart block. S/E Hypotension. Dilute in 5% dex or 0.9% N/S.
<b>Ketamine (inf)</b>	10-45 mcg/kg/min	10 mcg/kg/min	30 mg x wt	Anaesthetic, sialagogue. Hallucinations & emergence reactions worse in older children
<b>Labetalol (inf)</b>	0.5-3 mcg/kg/hr	1 mg/kg/hr	50 mg x wt	Neonates start at 500mcg/kg/hr. Hypertensive crisis. Start slowly. Avoid rapid reduction BP. Dilute in 5% dex or 0.9% N/S.
<b>Midazolam (inf)</b>	0.5-20 mcg/kg/min	1 mcg/kg/min	3 mg x wt	Sedation at lower end of range. Seizure control higher doses. Cardiovascular depression. Dilute in 5% dex or 0.9% N/S.

<b><i>Drug (inf = infusion)</i></b>	<b><i>Dose range</i></b>	<b><i>1ml/hr =</i></b>	<b><i>Add to 50ml</i></b>	<b><i>Notes</i></b>
<b>Milrinone (inf)</b>	0.3-0.75 mcg/kg/min	0.5 mcg/kg/min	1.5 mg x wt	Phosphodiesterase inhibitor. Vasodilator & inotrope. Dose reduction in renal/liver dysfunction. Dilute in 5% dex or 0.9% N/S. May be administered centrally undiluted in fluid restriction.
<b>Morphine (inf)</b>	5-100 mcg/kg/hr	20 mcg/kg/hr	1 mg x wt	Bigger children may need higher doses for a few hours. Dilute in 5% dex or 0.9% N/S.
<b>Noradrenaline (inf)</b>	0.1-1 mcg/kg/min	0.1 mcg/kg/min	0.3 mg x wt	Dilute in 5% dex or 0.9% N/S. Potent vasopressor. Administer centrally
<b>Propofol 1% (inf)</b>	1-4 mg/kg/hr	10 mg/hr	0 mg x wt	1% = 1 kcal/ml in lipid. Use undiluted. Prolonged or high dose infusion associated with propofol syndrome (lactic acidosis and tachycardia)
<b>Prostin (inf)</b>	5-100 ng/kg/min	10 ng/kg/min	30 mcg x wt	Dinoprostone. NANOGRAMS. Dosing up to 100ng/kg/min for 30-60 mins. Apnoea common in first 24hrs. SE hypotension, flushing, diarrhoea, low grade temperature. Dilute in 5% dex or 0.9% N/S
<b>Salbutamol (inf)</b>	1-5 mcg/kg/min	0.5 mcg/kg/min	1.5 mg x wt	Dilute in 5% dex or 0.9% N/S. Preferable dilution is 25mg/50ml. Central administration if possible.
<b>Sodium bicarbonate 8.4%(inf)</b>	1-2 mmol/kg/hr	1 mmol/hr	0 mmol x wt	Renal alkalisation. Very alkaline. High extravasation risk. Central administration preferable. Dilute 1:10 peripherally.
<b>Sodium nitroprusside (inf)</b>	1-5 mcg/kg/min	1 mcg/kg/min	3 mg x wt	Protect from light. Tachyphylaxis after 24 hrs. Toxicity with rising lactate and mixed venous saturations.
<b>Thiopental (inf)</b>	1-8 mg/kg/hr	1 mg/kg/hr	0 mg x wt	Reconstitute with 20ml WFI to give 25mg/ml. Further dilute with 0.9% NS if required. Status epilepticus. Accumulates in fat. Cardiovascular suppression. Extravasation risk
<b>Vasopressin (inf)</b>	0.001-0.002 unit/kg/min	0.0005 unit/kg/min	1.5 units x wt	Dosing range: low=0.0001u/kg/min; standard= 0.00025u/kg/min; high=0.0005u/kg/min; max= 0.002u/kg/min. Dilute in 5% dex or 0.9% N/S.

# NUTRITION

Check with ttt



Check with GIT

## Routes

- Oral.
- Enteral: Ryle (nasogastric or nasojejunal), Gastrostomy, Jejunostomy.
- Parenteral (Partial or total).
- Mixed enteral and parenteral (if patient is losing weight with enteral feeding).

- 📖 Target: To start enteral feeding as soon as possible to prevent bacterial translocation (fecal capsules), at least trophic 20 ml/hr.
- 📖 Oral fluids are good expectorants and improve chest condition.
- 📖 Don't rely on intestinal sounds to start enteral feeding.
- 📖 Early ambulation is important in paralytic ileus.
- 📖 **Surprises:** Enteral feeding is no longer contraindicated in patients on high doses of vasopressors. Once the dose is stabilized, enteral feeding should be started

## Oral Feeding

- Sitting 30° - 45°
- Alert
- Patient has access to food . الاكل جنب العيان طول الوقت يقدر يطوله بإيده
- Balance every 4 hours & ensure adequate oral intake, If inadequate → supplement by IV fluids to achieve 2 liters/day.
- Fixed volume per hour.
- The first time should be witnessed especially if stroke patient to exclude bulbar symptoms.
- Clear fluids in case aspiration occurs.
- High protein diet يعني نص فرخة في اليوم زائد فيتامينات e.g. ensure, multivitamins
- 1<sup>st</sup> day → overlap Ryle feeding & Oral, if adequate → remove Ryle

## Ryle Feeding

1. Initiation: Ryle test

2. Contents: 1 ml = 1 Kcal.

- قاذورات (رايل المستشفي) لا يسمن و لا يغني من جوع
- High protein diet.
- Supplementation (enrich, biogainer).
- Full enteral nutrition: (expensive 1500 L.E/day)
  - Frusebein 1 سم بيدي 1 كالوري و 1 سم بيدي 2 كالوري
  - Peptamin

العيان يفضل يأخذ enteral feeding طالما ماسك ضغط حتي لو ماشي علي muscle relaxant أو inotropes .

3. Methods:

- ◆ Continuous infusion (the best) (there is no such thing as night vacation)
- ◆ Intermittent boluses → by gravity بسرنة رايل  
→ by force (obsolete)

Wash with 10 ml distilled water after each bolus to avoid fermentation of food inside ryle tube

#### 4. Length & Route:

- Length: In adults between 2<sup>nd</sup> & 3<sup>rd</sup> marks ... In children has to be measured.
  - Route:
    - Nasal
    - Oral → only in intubated patients (in the following conditions: fracture base, bleeding tendency, difficult insertion) otherwise it increases risk of aspiration.
    - If non-intubated with fracture base (cribriform plate):
      - Unilateral fracture → place Ryle nasal in healthy side very cautiously, not forced & under vision
      - Bilateral fracture → do not insert Ryle
- If irreversible cause or Ryle for > 1 month → consider gastrostomy (either surgical or endoscopic).

#### 5. Insertion:

- Non-intubated:
  - Place Ryle in fridge
  - Head elevated
  - Stop at oropharynx
  - Wet cotton and ask patient to swallow
  - With first swallow → push Ryle
- Magil Insertion: Elevate epiglottis with laryngoscope.
- Esophageal tube: وانت بتقطعها ايدك هتقطع لف ايدك بشاش

#### 6. Indications: When enteral feeding is okay but oral route is not:

- ◆ Intubated patient
  - ◆ DCL
  - ◆ Bulbar symptoms
  - ◆ Maxillo-facial trauma
- Ryle should be inserted for gaseous distension with:
- Resection anastomosis “suspected leak”
  - Respiratory distress
  - Metabolic acidosis

#### 7. Purpose: Ryle is inserted either for feeding or drainage.

- Feeding: Open every 6 hours to check residual volume → 300-500 ml → Intolerance → stop & do the following:
  - Give prokinetics
  - Electrolyte correction
  - Gradual increase of volume
  - Consider bypassing stomach to reach jejunum or do jejunostomy
- Drainage → make sure it drains properly.

لو انت حاطط الرايل علشان تفضي بطن العيان و لقيت كيس الرايل فاضي و بطن العيان منفوخة يبقى الرايل مسدود ولازم تعمله flush .

#### 8. Precautions:

- Patient in semi sitting position all through feeding
- Initiate with Ryle test
- Residual volume during course

## 9. Complications:

- Of Ryle:
  - ◆ Sinusitis, septal perforation, pharyngitis.
  - ◆ Malposition, endotracheal, kinking.
  - ◆ Tracheo-esophageal fistula.
  - ◆ Aspiration.
- Of Feeding:
  - ◆ Related to formula: Intolerance, hypo/hyper electrolytes.

## 10. Termination:

- Adequate oral intake (after problem resolved).
  - After 40 days → Gastrostomy (endoscopic or surgical).
- If patient deteriorates after gastrostomy consider peritonitis.

## Parenteral Nutrition

- Can be total PN or partial PN

### 1. Route & Daily Requirements:

- Route: Central Line with interlipid in a separate line
- Daily Requirements:

- Fluids: 30 - 45 ml/kg/day بنحسب علي العالي
- In pediatrics → volume is calculated as :
  - 1st 10 kg → 100 ml/kg/day
  - 2nd 10 kg → 50 ml/kg/day
  - Every 10 kg → 25 ml/kg/day
- Calories: 30-40 Kcal/Kg/day بنحسب علي الواطي + consider stress factor.
- Calories are given as 70% glucose and 30% lipid.
- Protein: 1- 2 gm/kg/day (not counted from caloric intake).
- Potassium: 1 - 2 mEq/kg/day. - Sodium: 1 - 2 mEq/kg/day.
- Magnesium: 300 mg/day (0.3 mmol/kg/day).
- Calcium: 300 mg/day (0.1 mmol/kg/day).
- Trace elements: iron, addamil, glycophos (ampoule/L).
- Vitamins (soluvit + vitalipid), if not available → Give vitamin K, cevarol, becozyme.
- 1 gm glucose = 1 gm protein = 4 Kcal.
- 1 gm lipid = 9 Kcal.
- 500 cc of glucose 5% = 25 gm = 100 Kcal
- 500 cc of glucose 10% = 50 gm = 200 Kcal (in peripheral or central line).
- 500 cc of glucose 25% = 125 gm = 500 Kcal (in central line).
- 500 cc of Intralipid 10% = 450 Kcal (in peripheral or central line).
- 500 cc of intralipid 20% = 900 Kcal (in peripheral or central line).

ال intralipid مينفعش يتساب متعلق للعيان أكثر من 12 ساعة لأن ال lipid يعتبر medium for bacteria و ممكن يدخل العيان في sepsis .

- 500 cc of aminostril 10% = 50 gm protein (in central line)
- 500 cc of aminolipan N-hep 8% = 40 gm protein (branched aminoacids → aromatic aminoacids → in central line).
- Nephrostril 6% for renal patients اتلغي من الطب



- Dipeptivan is preferred in burn and neuro patients.
- Panamen G 2.7% & Panamen SG 8% have high chloride content.

☞ Potassium can be given via peripheral line only if **وريد كبير و بوتاسيوم مخفف** .

☞ Drugs that cause thrombophlebitis if given in peripheral vein:  
Cordarone, Aspegic (Acetyl-salicylic acid) & Potassium.

## 2. Type:

- Separate components
- Preformed e.g. smof kapiivan or nutrition unit

## 3. Indications:

- ◆ Paralytic Ileus: Correct electrolyte disturbance, give prokinetics & early ambulation.  
If persistent after 3 days → exclude surgical cause (mechanical obstruction or leakage).
- ◆ Intolerance to enteral feeding.
- ◆ GIT leakage.
- ◆ GIT anastomosis: small intestine (3 days), large intestine (5 days), gastric (7 days).

☞ الكفرة يقولوا → Immediate oral intake after GI anastomosis improves healing if compared with 3 days delay.

- ◆ High Inotropic support

يعني maximum levo, maximum adrenaline و مش ماسك ضغط

## 4. When to start:

- NUTRIC Score

## 5. Complications of PN:

- Related to Central line.
- Related to formula:  
كل حاجة: Hypo and hyper
  - Volemia
  - Glycemia
  - Proteins
  - Vitamins
  - Trace elements
  - Lipids

### ➤ Monitoring of TPN:

- Electrolytes → daily.
- Glucose every hour until stabilized then every 6 hours.
- Liver functions & CBC → weekly.
- Kidney functions → every 2 weeks.

☞ لو عايز تبدأ للعيان oral or enteral feeding و خايف يكون عنده leak لازم تعمل:  
Abdominal US / 12 hrs + CT with oral contrast + methylene blue

## Refeeding syndrome

ده عيان كان malnourished فترة طويلة و جالك الرعاية وانت بدأته تغذية بال full requirements من الأول سواء enteral or parenteral nutrition

➤ **Clinical picture:**

- ◆ Severe acidosis, hypotension & organ dysfunction up to cardiac arrest.
- ◆ Severe electrolyte imbalance (hypokalemia, hypomagnesemia, hypophosphatemia & hypoglycemia)

➤ **Pathogenesis:** Intracellular shift of phosphate, potassium & magnesium.

➤ **Management:**

- ◆ Prevention: Start with 50% of caloric needs and gradually increase intake as tolerated.
- ◆ Supportive treatment.
- ◆ Supplement with potassium, magnesium & phosphorus.

### استلام الرعاية

1. ظرف الغرامات

➤ Database on computer + excel sheet + hard copy of admission, discharge/mortality & cumulative balance.

2. مواعيد تعقيم البلازما

3. المكنة الجديدة و القديمة بتوع الغسيل

4. اجهزة الرعاية زي السونار و الايكو

5. التلاجة بمحتوياتها من الادوية زي streptokinase, glypressin, precedex

6. مفاتيح الاوضة

7. Cardiometry

8. Drugs:

- Group A:

Morphine, Nalufen, Fentanyl, Katalar

- Group B:

Diprivan, Tracium, Dormicum

9. Bronchoscopes: Grey, Green, Orange

10. Study protocol

11. Persepsin

12. CVLs & Mahurkers

13. Paperwork (ورقيات):

Admission sheet, mortality/discharge sheets, lab sheet, cumulative balance, checklist... etc.

# استلام العيانيين

- Admission sheet + lactate, RBS, EF, CVP
- Progress notes
- Lab sheet
- POCUS sheet
- Cumulative balance
- Problem sheet
- Cultures sheet
- Drug sheet
- Fluids sheet

# PROBLEMS

	Diagnosis	/	/	/	/	/	/	/	/	/	Yes	No	Done
<b>Chronic</b>													
<b>Acute</b>													
<b>CNS</b>	DCL (69) Convulsions (70) Fracture spine (69)												
<b>CVS</b>	Shock (40) Active bleeding (41) Chest pain (43) Arrhythmias (51) Hypertensive emergency (81) Infective endocarditis (67) Limb ischemia												
<b>Respiratory</b>	Hypoxia (10) Hypercapnea Flail chest (8) Tight chest												
<b>GIT</b>	Vomiting												
<b>Hepatic</b>	Hepatic encephalopathy (85) Hematemesis (86) Hepatorenal syndrome (86) Spontaneous bacterial peritonitis (87) Hepato-adrenal syndrome (87) Hepatopulmonary syndrome (87)												
<b>Renal</b>	AKI (76)												
<b>Blood gases</b>	Acidosis & Alkalosis (34)												
<b>Labs</b>													
<b>Balance</b>													
<b>Others</b>													



<b>Chronic devices problems</b>	/	/	/	/	/	/	/	/	/	Yes	No	Done
Endotracheal tube (20)												
CVL (17)												
Tracheostomy (15)												
Chest tube (16)												
Surgical wound (11)												
Stomas (11)												
Bed sores (13)												
Urinary catheter												
Ventilator (18)												
Nutrition: volume & type (93)												

<b>Body</b>	/	/	/	/	/	/	/	/	/	Yes	No	Done
Head & neck												
Upper limbs												
Abdomen & back												
Lower limbs												